SANYO

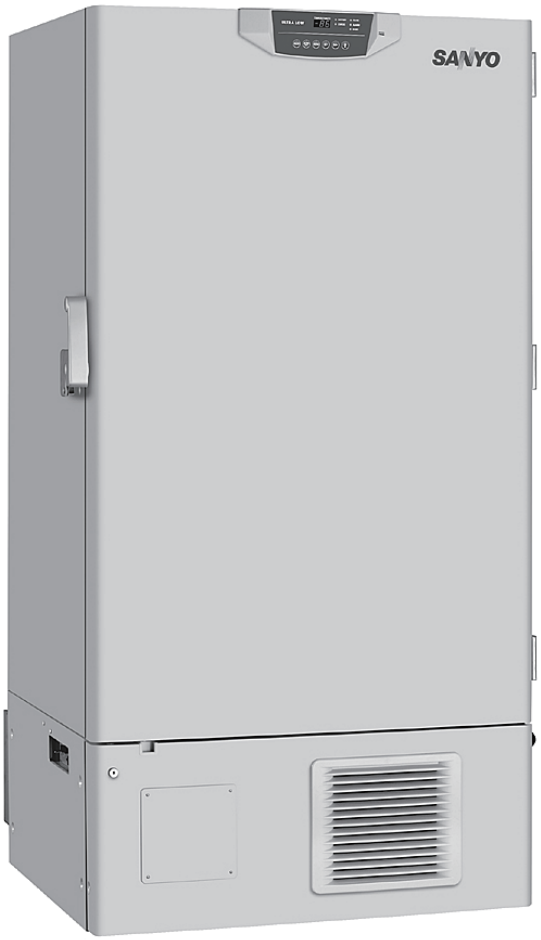
Service Manual

Ultra-Low Temperature Freezer

FILE No.

MDF-U74V
MDF-U74VC

SANYO Electric Co., Ltd.
Biomedical Business Division



SM9910225

Effective models

This service manual is effective for following models.

Model name	Product code	Voltage and Frequency	
MDF-U74V	823 020 52	220V	50Hz
	823 020 53	220V	60Hz
	823 020 54	230V	50Hz
	823 020 55	220V	60Hz
	823 020 56	220V	50Hz
	823 020 57	220V	60Hz
MDF-U74VC	823 020 80	220V	60Hz

Contents

Specifications

■Structural specifications

Item	MDF-U74V	MDF-U74VC
Name	Ultra-low Temperature Freezer	
External dimensions	W1010 × D870 × H2010 (mm)	
Internal dimensions	W870 × D600 × H1400 (mm)	
Effective capacity	728 L	
Outer door	1door, painted steel	
Inner door	2doors, ABS resin panel with stainless frame	
Insulation	Vacuum insulation panel + rigid polyurethane foamed-in place	
Exterior	Painted steel	
Interior	Painted steel	
Shelf	3shelves, stainless steel Inner dimensions; W848 x D533 (mm)　Load; 50kg/shelf	
Outer door latch	1pc	
Outer door lock	1pc	
Caster	4pcs（leveling leg：2pcs）	
Monitoring hole	3places(Rear upper, back right bottom, back left bottom) Inner diameter; φ17mm	
Refrigeration circuit	Cascade refrigeration system	
Compressor	High stage side; Hermetic type, Output; 1100W Low stage side; Hermetic type, Output; 1100W	
Evaporator	High stage side; Cascade condenser Low stage side; Tube on sheet（Sharing with interior）	
Condenser	High stage side; Fin and Tube type Low stage side; Cascade condenser	
Refrigerant	High stage side; R-407D Low stage side; R-508	
Refrigerant oil	Ze-NIUSL22SA	
Power supply	Local voltage	
Weight	346 Kg	351 Kg
Accessories	1 set of key, 1 scraper	
Optional component	Automatic temperature recorder(MTR-G85) Back-up system (CVK-UB2, CVK-UB2(I)); LCO_2, (CVK-UBN2);LN_2 Inventory rack (IR-220, IR-224U） Independent inner door (MDF-7ID)	

■Control specifications

Item	MDF-U74V	MDF-U74VC
Temp. controller	Micro-processor control system Temperature setting range: -50℃～-90℃ (Unit:1℃) Non-volatile memory	
Thermal sensor	Pt.1000Ω	
Temperature display	LED display (Unit:1℃)	
High temp. alarm	When chamber temp. reaches to set temp.+5℃~+20℃ (Factory default; +10℃), high temp. alarm emits. ALARM lamp blinks, audible alarm sounds intermittently after 15min. passes. Remote alarm contact; Normal Open, Normal Close Contact activates in reverse after 15min. passes. Allowable contact capacity; Max. 30VDC, 2A	
Low temp. alarm	When chamber temp. reaches to set temp.-5℃~-20℃ (Factory default; -10℃), low temp. alarm emits. ALARM lamp blinks, audible alarm sounds intermittently after 15min. passes. Remote alarm contact; Normal Open, Normal Close Contact activates in reverse after 15min. passes. Allowable contact capacity; Max. 30VDC, 2A	
Door alarm	When a door leaves open, DOOR lamp illuminates after 2min. passes.	
Filter alarm	When a condenser filter is clogged, FILTER lamp illuminates and audible alarm sounds intermittently.	
Power failure alarm	When a power is interrupted, ALARM lamp blinks, audible alarm sounds intermittently and remote alarm contact outputs.	
Remote alarm	Remote alarm terminal 3P; Max. DC30V、2A N.C.-COM, N.O.-COM When temp. alarm or power failure alarm emits, or when sensor is failed, remote alarm contact activates in reverse.	
Notice of battery life	When battery accumulation time reaches to approx. 3years, BATTERY lamp illuminates.	
Notice of fan motor life	When fan motor accumulation time reaches to approx. 6years, BATTERY lamp blinks.	
STATUS function	Status-1: When a temperature in AT sensor is lower than 0℃ or higher than +35℃, it diagnoses that the ambient temperature is abnormal.	
	Status-2: When a power supply voltage is lower than rated voltage -15%, it diagnoses that the power supply voltage is abnormal.	
	Status-3: When a running rate of compressor L is higher than 95%, it diagnoses that unit is in overloaded operation.	
Lamps and keys on Control panel	Lamps: ALARM, BATTERY, STATUS, DOOR, FILTER Buzzer stop key: BUZZER Alarm test key: ALARM TEST Status key: STATUS Set key: SET Digit shift key: ▶▶ Numerical value shift key: ▲	
Key Lock	Press ▶▶ key for 5 seconds to display Key Lock mode. L0: Key Lock is OFF L1: Key Lock is ON	
Compressor protection	When a temperature in cascade sensor is lower than -34℃, compressor L turns on. When a temperature in cascade sensor is higher than -12℃, compressor L turns off. When a temperature in filter sensor is higher than +60℃, compressor H turns off. Overload relay	
Start delay	If several units are installed on a same site, it is possible to set delay time not to start them simultaneously after they returns from power failure. Setting range: 3~15 minutes (Unit: 1 minute) It is impossible to set delay time individually by units.	

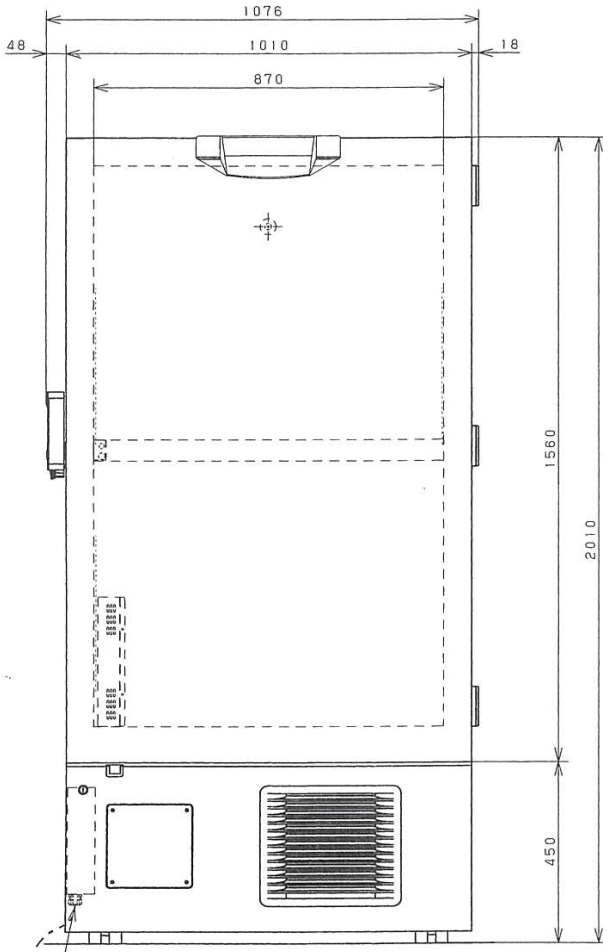
■Performance specifications

Model	MDF-U74V			
Cooling performance	-86°C at the center of the chamber (ambient temperature; 30°C, no load)*			
Temperature control range	-50°C to -86°C (ambient temperature; 30°C, no load)			
Power source	220 V, 50 Hz	220 V, 60 Hz	230 V, 50 Hz	240 V, 50 Hz
Rated power consumption	1050 W	1230 W	1120 W	1170 W
Noise level	51 dB [A] (background noise; 20 dB)			
Maximum pressure	2680 kPa			

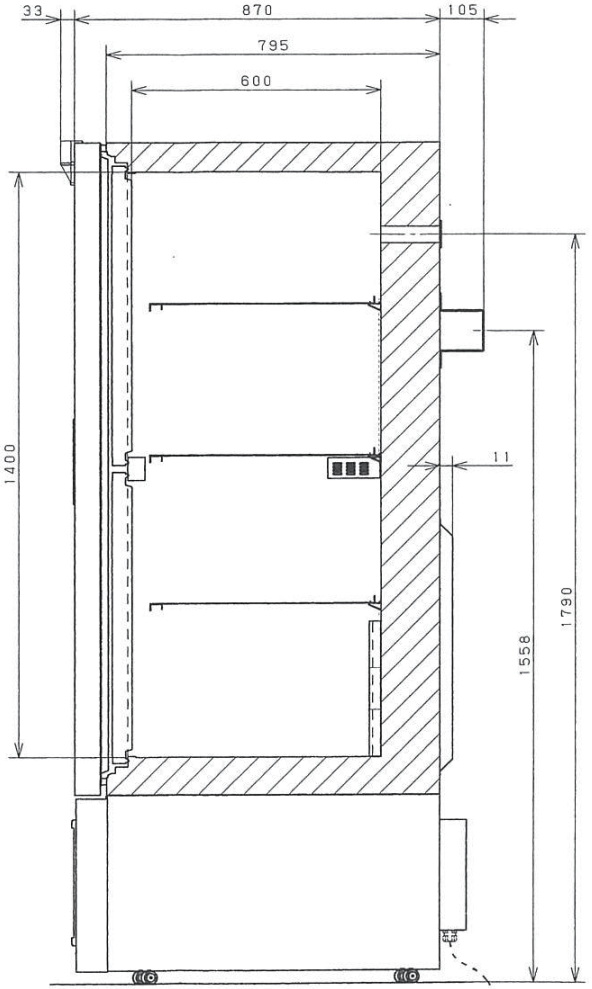
Model	MDF-U74VC
Cooling performance	-86°C at the center of the chamber (ambient temperature; 30°C, no load)*
Temperature control range	-50°C to -86°C (ambient temperature; 30°C, no load)
Power source	220 V, 60 Hz
Rated power consumption	1230 W
Noise level	51 dB [A] (background noise; 20 dB)
Maximum pressure	2680 kPa

* Design or specifications will be subject to change without notice.

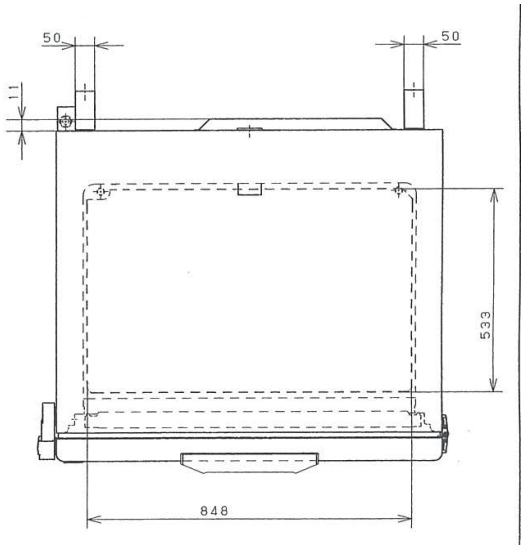
Dimensions



<Front view>

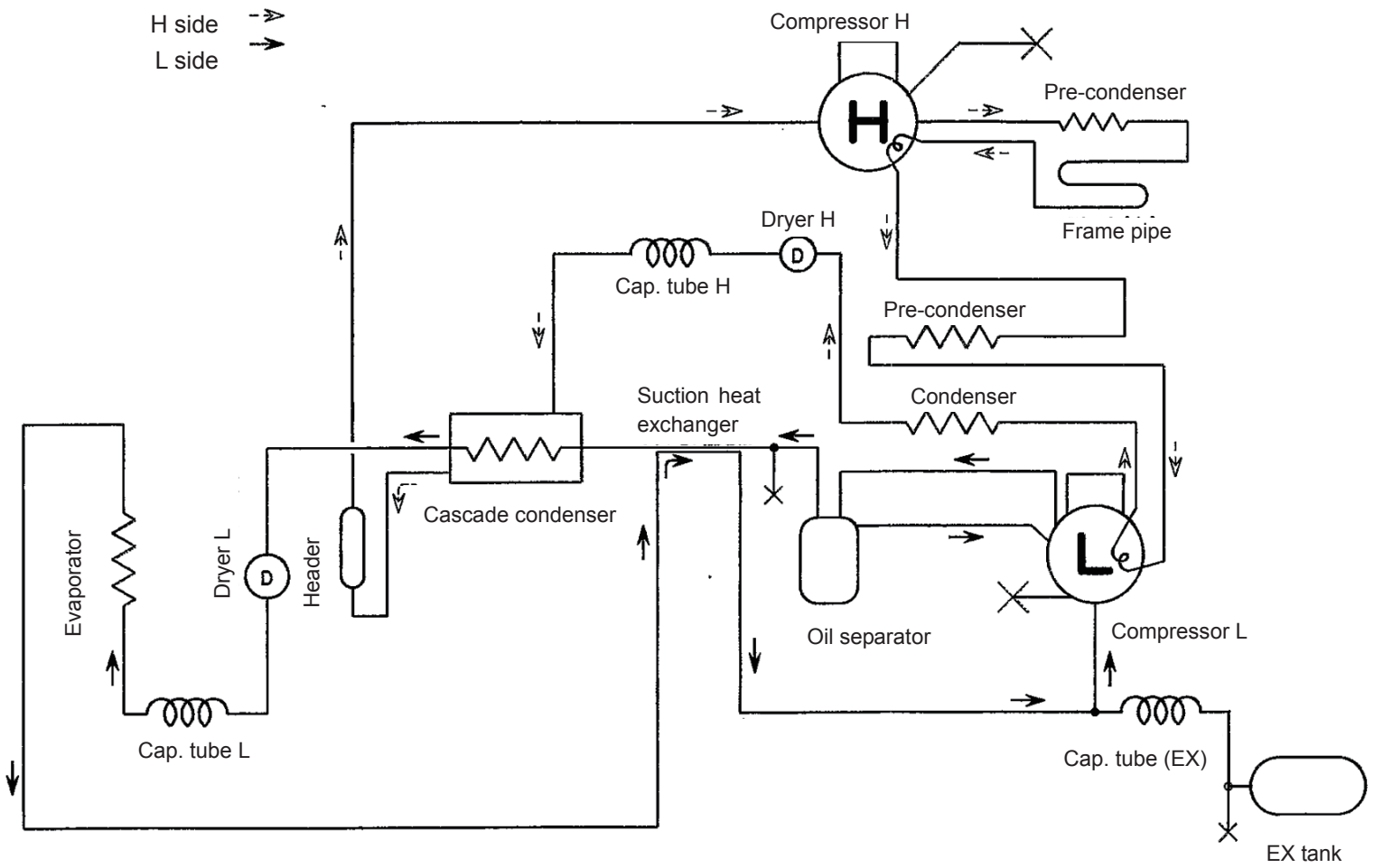


<Side view>



<Overlook view>

Cascade refrigeration system



X => Evacuation points

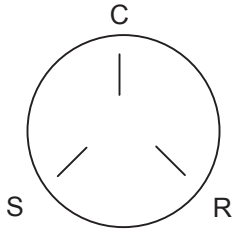
Cooling unit parts

<MDF-U74V/U74VC>

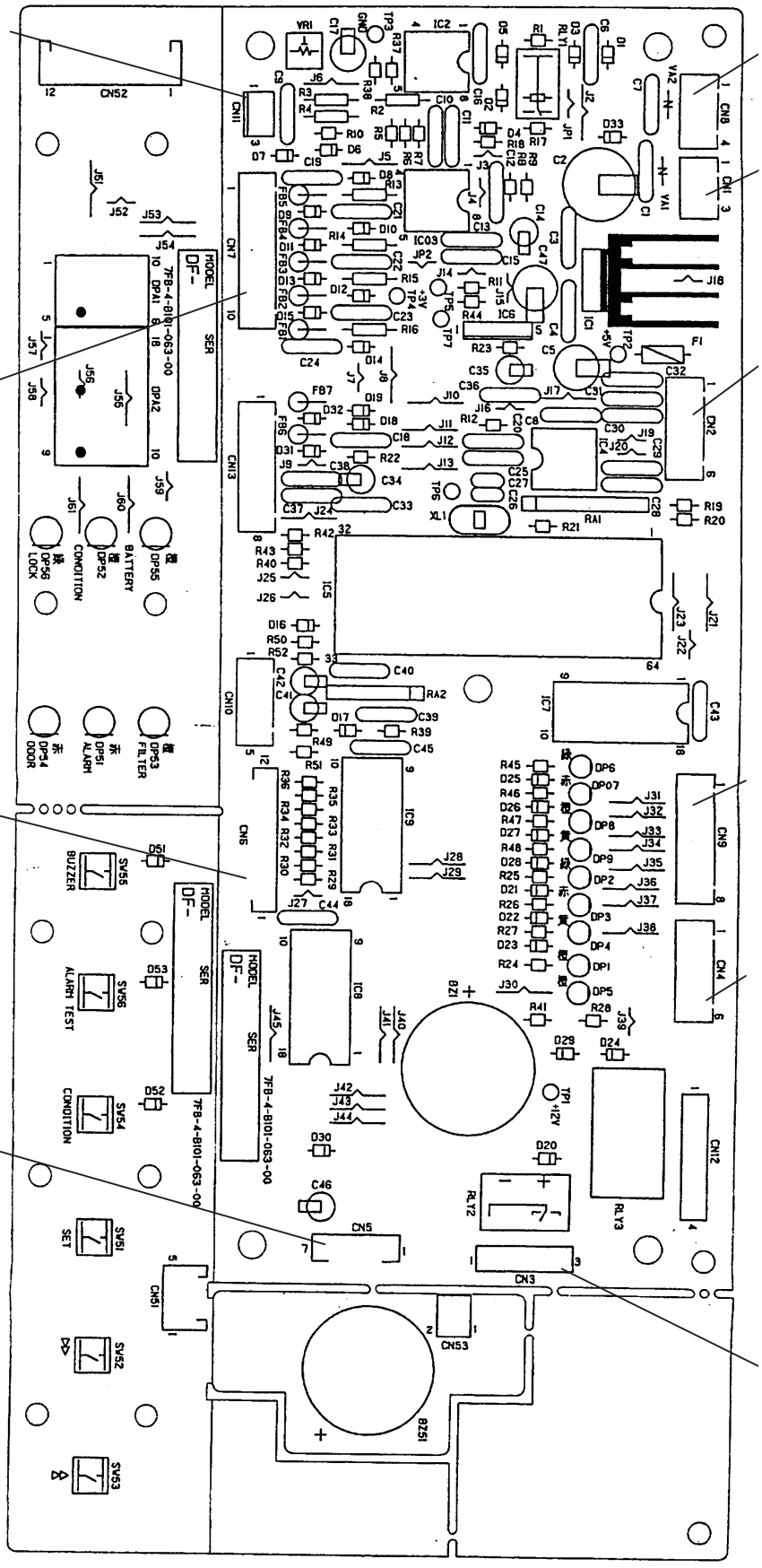
Item	Specifications		
	H side	L side	
Compressor			
220V, 50Hz	Type:KS370J1NS-4A Code:7FB-0-M101-001-04		
230/240V, 50Hz	Type:KS370J1NS-4A1 Code:7FB-0-M101-001-05		
220V,60Hz	Type:KS370J1NS-7A Code:7FB-0-M101-001-06		
*220V, 50Hz	Type:KS370J1NS-4AD Code:7FB-0-M101-001-07		
Refrigerant oil	Ze-NIUSL22SA Charged q'ty: 850cc		
Cooling system	Forced air cooling（partially）and oil cooler		
Condenser			
Type	Fin and tube	Cascade condenser	
Condenser	12 columns x 4 lines P6.35mm Fin 88pcs.	Coil pipe ϕ6.35mm	
Pre-condenser	W 350mm	——	
Frame pipe	ϕ6.35mm	——	
Evaporator Type	Cascade condenser Shell and tube ϕ80mm	Tube on sheet ϕ9.52mm	
Capillary tube			Ex. capillary
Resistance PSI・kg/cm^2	78 PSI	0.37Mpa	34 PSI/G
Length	3000mm	3000mm	500mm
Outer diameter	ϕ2.4mm	ϕ2.0mm	ϕ2.4mm
Inner diameter	ϕ1.2mm	ϕ0.9mm	ϕ1.2mm
Refrigerant	R-407D Charged q'ty: 606g	R-508 Charged q'ty: 320g	
Oil additive	n-Pentane Charged-q'ty: 39g	n-Pentane Charged q'ty: 46g	
Dryer	4A-XH-9 Charged q'ty: 18g	4A-XH-6 Charged q'ty: 58g	
Condensing fan	ϕ230 mm, 4 blades Material: ABS	——	
Condensing fan motor	Type:SV4-11AA5P	——	
Oil separator	——	Type:SPK-0S02S2	

* … Compressor for CCC Authorization

<Compressor terminals layout>



Components on PCB



CN11
#1-#3: To Temp. sensor

CN7
#1-#2: To Door SW
#5-#6: To AT sensor
#7-#8: To Filter sensor
9- # 10: To Cascade sensor

CN6
To LCD PCB

CN5
#1-#5: To Switch PCB
#6-#7: To Buzzer PCB

CN8
#1-#2: To Battery

#3-#4: To Transformer

CN1
#1-#3: To Switching power supply

CN2
To MTR-480（Option）
To MTR-L03（Option）

CN9
#1-#2: To H comp. relay

CN4
#1-#2: To Temp. control relay
#3-#4: To Heater relay

CN3
To Remote alarm terminal
#1:COM.
#2:N.O.
#3:N.C.

Connections on PCB

The following shows the connections of connectors on the Temp. controller PCB.

Connector	Connects to	Usage
CN1	Switching power supply	To supply the power to PCB.
CN2	Network interface	To connect to MTR-480, MTR-L03（option）
CN3	Remote alarm terminal #1: COM. #2: N.O. #3: N.C.	Remote alarm contact outputs. In normal condition, open for #1-#2 and closed for #1-#3.
CN4	#1-#2：Temp. control relay #3-#4：Heater relay	To control chamber temperature (12VDC) To supply the power to Cap. tube heater (12VDC)
CN5	#1-#5: Switch PCB #6-#7: Buzzer	To connect to each switch
CN6	Display PCB	To connect to each LED
CN7	#1-#2: Door switch #5-#6: AT sensor #7-#8: Filter sensor #9-#10: Cascade sensor	To control the door switch To detect the ambient temperature To detect the temperature in condenser outlet pipe. To detect the temperature in cascade.
CN8	#1-#2: Battery（#1:6V #2:Battery switch） #3-#4: Transformer	To supply the power during power failure To supply the power to PCB.
CN9	#1-#2: H. Comp. relay	To control compressor H ON/OFF (12VDC)
CN10	Unused	
CN11	#1-#3: Temp. sensor	To detect the internal temperature.

Electrical Parts

MDF-U74V/U74VC		220VAC, 60Hz	220VAC, 50Hz	230/240VAC, 50Hz
Compressor	Type	KS370J1NS-7A	KS370J1NS-4A	KS370J1NS-4AI
	Code	7FB-0-M101-001-06	7FB-0-M101-001-04	7FB-0-M101-001-05
	Rated voltage (50/60Hz)	220V, 60Hz	220/230V, 50Hz	230/240V, 50Hz
	Winding resistance C-R(Main)	1.64Ω	2.53Ω	2.53Ω
	C-S(Aux)	3.35Ω	4.8Ω	4.8Ω
Starting relay	Type	AMVL-300A	AMVL-300A	AMVL-300A
	Pick up voltage	215~247VAC(60Hz)	185~217VAC(50Hz)	185~217VAC(50Hz)
	Drop out voltage	69~132VAC(60Hz)	60~120VAC(50Hz)	60~120VAC(50Hz)
Overload relay	Type	MRA999549201	MRA999539201	MRA999539201
	Action to the temp. (no current)	ON:69±11℃ OFF:135±5℃	ON:69±11℃ OFF:135±5℃	ON:69±11℃ OFF:135±5℃
	Action to the current (AT25℃)	29.5A	22.5A	22.5A
	Operation time	6~16sec.	6~16sec.	6~16sec.
Starting capacitor	Rating	250VAC, 160MF	250VAC, 100MF	250VAC, 100MF
Running capacitor	Rating	400VAC, 25MF	400VAC, 25MF	400VAC, 25MF
Fan motor capacitor (H)	Rating	1.0MF	1.0MF	1.0MF
Condensing fan motor	Type	SV4-11AA5P	SV4-11AA5P	SV4-11AA5P
	Rating	220-240VAC, 10W	220-240VAC, 10W	220-240VAC, 10W
Capitube heater	Rating	230V, 11.2W	230V, 11.2W	230V, 11.2W
	Resistance	4700Ω	4700Ω	4700Ω
H Comp. relay	Type	G4F-11123T	G4F-11123T	G4F-11123T
	Contact capacity	20A, 250VAC	20A, 250VAC	20A, 250VAC
	Coil	12VDC	12VDC	12VDC
	Parts code	624 173 2397	624 173 2397	624 173 2397
Heater relay	Type	G2R-1A-T	G2R-1A-T	G2R-1A-T
	Contact capacity	10A, 250VAC	10A, 250VAC	10A, 250VAC
	Coil	12VDC	12VDC	12VDC
	Parts code	624 188 9299	624 188 9299	624 188 9299
Temp. control relay	Type	G4F-11123T	G4F-11123T	G4F-11123T
	Contact capacity	20A, 250VAC	20A, 250VAC	20A, 250VAC
	Coil	12VDC	12VDC	12VDC
	Parts code	624 173 2397	624 173 2397	624 173 2397
Switching power supply	Type	LDA10F-12	LDA10F-12	LDA10F-12
	Rated output	12VDC, 0.9A	12VDC, 0.9A	12VDC, 0.9A
	Parts code	624 226 2053	624 226 2053	624 226 2053
Temp. sensor	Type	SS-12-T	SS-12-T	SS-12-T
	Rating	1000Ω	1000Ω	1000Ω
AT sensor	Type	502AT	502AT	502AT
	Rating	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃
Filter sensor	Type	502AT	502AT	502AT
	Rating	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃
Cascade sensor	Type	502AT	502AT	502AT
	Rating	5KΩ, 25℃	5KΩ, 25℃	5KΩ, 25℃
Door switch	Type	SDKNA20700	SDKNA20700	SDKNA20700
	Rating	5V, 5MA	5V, 5MA	5V, 5MA
Noise filter	Type	ZAC2220-11	ZAC2220-11	ZAC2220-11
	Rating	250VAC, 20A	250VAC, 20A	250VAC, 20A
Battery switch	Type	SLE6A2-5	SLE6A2-5	SLE6A2-5
	Rating	250VAC, 4A	250VAC, 4A	250VAC, 4A
Battery	Type	5HR-AAC	5HR-AAC	5HR-AAC
	Rating	6V, 1100mAH	6V, 1100mAH	6V, 1100mAH
	Parts code	624 209 9284	624 209 9284	624 209 9284
Handle heater	Rating	9VAC, 0.83W	9VAC, 0.83W	9VAC, 0.83W
Transformer	Type	S41-U097PV	S41-U097PV	S41-U097PV
	Primary	115V	115V	115V
	Secondary	230V	230V	230V
Breaker switch	Type	BAM215131	BAM215131	BAM215131
	Rating	250V, 15A	250V, 15A	250V, 15A
Boost relay (MDF-U74VC only)	Type	G7L-1A-TUB		
	Rating	30A, 220V, DC24V		
Power relay (MDF-U74VC only)	Type	DS1E-M-DC12V		
	Rating	12V, 0.6A, 125V		
Breaker switch (MDF-U74VC only)	Type	IR11A2E201R		
	Rating	250VAC, 20A		
Power transformer (MDF-U74VC only)	Type	ATR-HJ61TC-1		
	Rating	200, 225, 240V		
Power transformer (MDF-U74VC only)	Type	ATR-D35003		
	Rating	P;208V, S;230V		

* Compressor for CCC Authorization
Type: KS370J1NS-4A□ Code:7FB-0-M101-001-07

Specifications of sensor

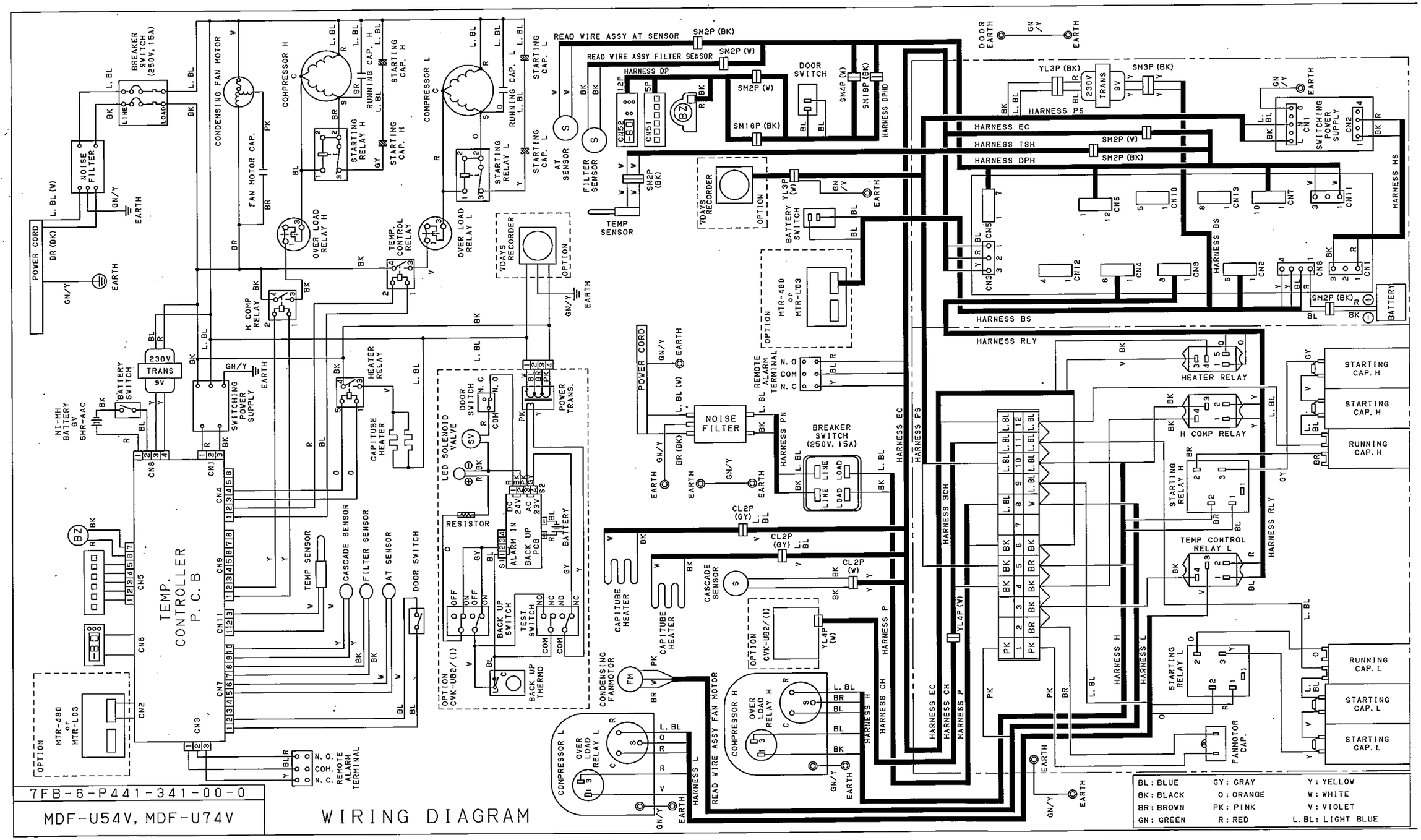
The following shows the temperature in thermal sensor (502AT-1) and its resistance value.

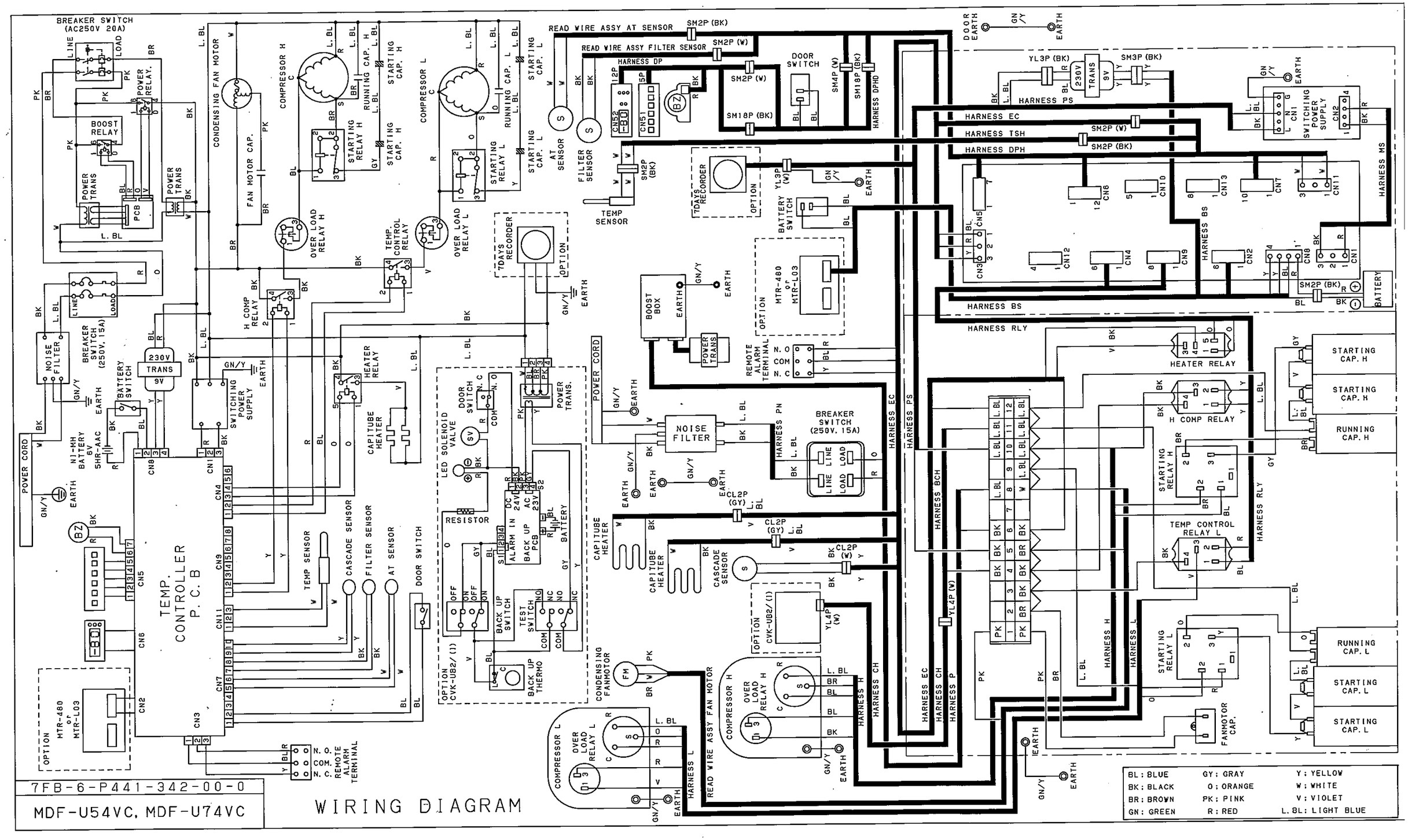
Temp. (C)	Resistance Value (kΩ)	Temp. (C)	Resistance Value (kΩ)	Temp. (C)	Resistance Value (kΩ)	Temp. (C)	Resistance Value (kΩ)
−50	154.5	−36	71.80	−22	35.65	0	13.29
−49	145.9	−35	68.15	−21	33.99	5	10.80
−48	137.8	−34	64.71	−20	32.43	10	8.84
−47	130.2	−33	61.48	−19	30.92	15	7.20
−46	123.1	−32	58.43	−18	29.50	20	6.01
−45	116.5	−31	55.55	−17	28.14	25	5.00
−44	110.2	−30	52.84	−16	26.87	30	4.17
−43	104.4	−29	50.23	−15	25.65	35	3.50
−42	98.87	−28	47.77	−14	24.51	40	2.96
−41	93.70	−27	45.45	−13	23.42	45	2.51
−40	88.85	−26	43.26	−12	22.39	50	2.13
−39	84.18	−25	41.19	−11	21.41	55	1.82
−38	79.80	−24	39.24	−10	20.48	60	1.56
−37	75.67	−23	37.39	−5	16.43	65	1.35

The following shows the temperature in thermal sensor (PT1000Ω) and its resistance value.

Temp. (C)	Resistance Value (Ω)	Temp. (C)	Resistance Value (Ω)	Temp. (C)	Resistance Value (Ω)
−140	450.83	−70	729.99	0	1000.0
−130	491.47	−60	769.02	10	1038.0
−120	531.83	−50	807.87	20	1076.0
−110	571.92	−40	846.58	30	1113.8
−100	611.76	−30	885.13	40	1151.4
−90	651.38	−20	923.55	50	1189.0
−80	690.78	−10	961.84	60	1226.4

Wiring diagram



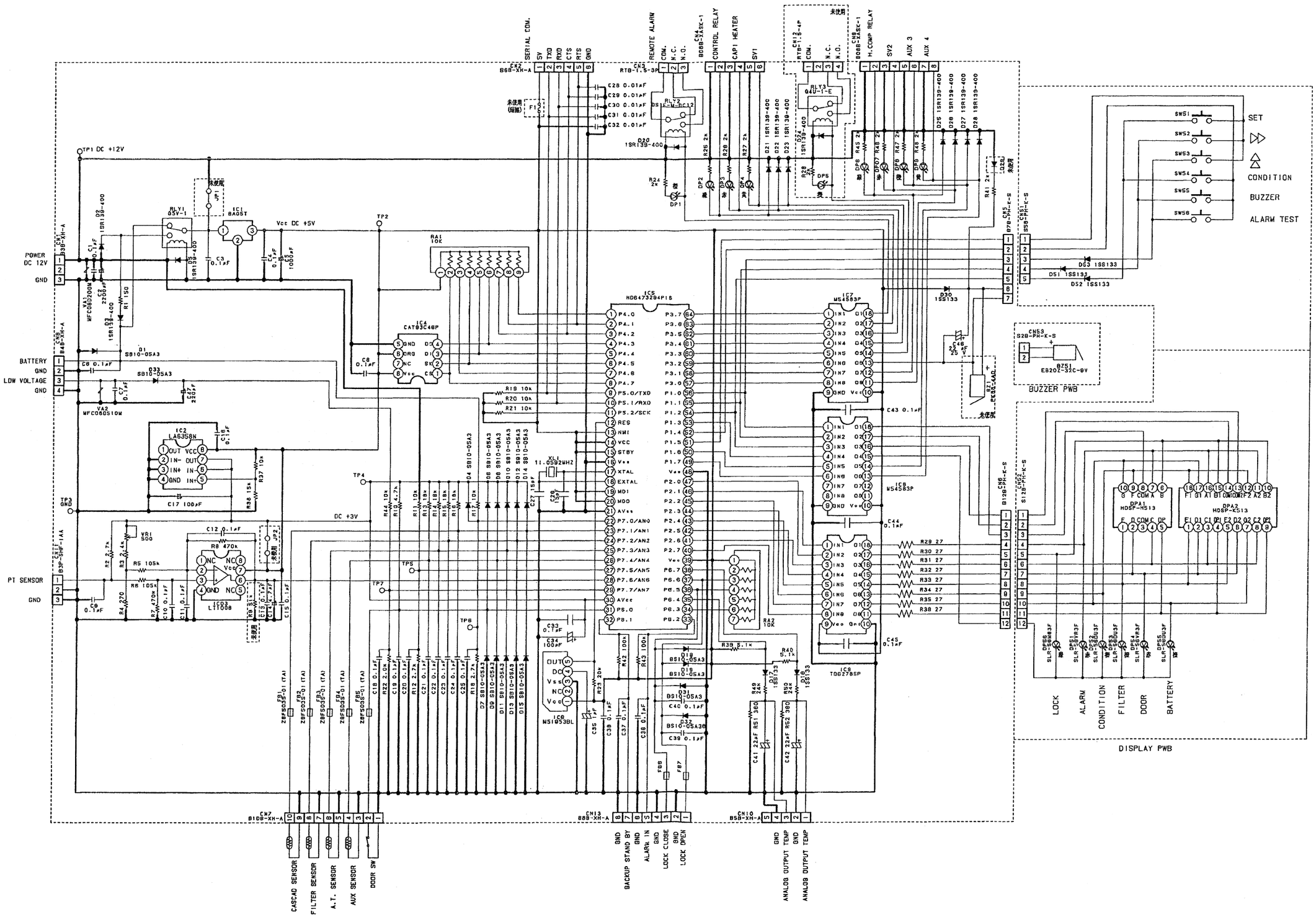


7FB-6-P441-342-00-0

MDF-U54VC, MDF-U74VC

WIRING DIAGRAM

Circuit diagram



Control specifications

1. Key and Switch

BUZZER : In alarm condition, audible alarm silences when this key is pressed.
Remote alarm activates and message is not eliminated.
When a power failure is occurred (battery back-up), press this key to show a chamber temperature for 5 seconds.

ALARM TEST : When this key is pressed, unit steps into Alarm Test mode with ALARM lamp blinks, intermittent buzzer beeps, digital LED goes off and remote alarm activates.
After an elapse time is about 90seconds, unit returns to normal condition. (Auto Return function)
If Alarm Test is performed when a battery switch is in off position, “E09” blinks on the display.

SET : Press this key once to activate setting mode with 2nd digit in LED blinks.
Press this key again to store a value to be changed.

STATUS : If this key is pressed during STATUS lamp illuminates, status code (‘--- 1’, ‘---2’ and ‘---3’) is displayed.


(Digit shift key) A blinking digit can change among 1st digit ~ 3rd digit with every time press this key.
If this key is pressed for 5 seconds when a chamber temperature is displayed, Key Lock activates with “L_0” is displayed.


(Numerical value shift key) A blinking digit can increase one by one every time press this key.
If this key is pressed for 5 seconds when a chamber temperature is displayed. Function mode activates with “F00” is displayed.

2. Temperature control

Setting range : -50℃~-90℃
Display range : -180~50
Setting procedure : Press SET key and set the required value with  key and key.
Press SET key to store the value to be changed.
Unacceptable setting range : If a value which is out of setting range is input and SET key is pressed, it is noticed the value cannot be set with audible alarm sounds for 1second.

3. Temperature alarm

Setting range : High temperature alarm … +5℃~+20℃ (Factory default: 10℃)
Low temperature alarm …. -5℃~-20℃ (Factory default: -10℃)
Setting procedure : Keep pressing  key over 5 seconds to step to function mode (F00). Input “F01” for high temperature alarm or “F02” for low temperature alarm.
Press SET key to set the value to be changed with the 1st digit blinks.
Press SET key again to store the value in the non-volatile memory.
Unacceptable setting range : If a value which is out of setting range is input and SET key is pressed, it is noticed the value cannot be set with audible alarm sounds for 1second.

4. Key Lock mode and Function mode

A) Key Lock mode
Setting range : 0 (Unlock), 1 (Lock)
Setting procedure: In chamber temperature display, press  key for 5 seconds to step to Key Lock mode. (“L_0” or “L_1” is displayed. Factory default: L_0)
Change the value with key and press SET key to store the value in the non-volatile memory.

B) Function mode

Setting range : 00~50

Display range : 00~59

00, 16 and 33~43, 44~49, 51~59 are unused.

Setting procedure : In chamber temperature display, press key for 5 seconds to step to function mode (F00 is displayed).

Change the blinking 1st digit to desired function code with key and key.

Press SET key to be function code available.

Unacceptable setting range : If a value which is out of setting range is input and SET key is pressed, it is noticed the value cannot be set with audible alarm sounds.

5. Error codes

E01: Temp. sensor is open circuited
E02: Temp. sensor is short circuited
E03: Cascade sensor is open circuited
E04: Cascade sensor is short circuited
E05: Filter sensor is open circuited
E06: Filter sensor is short circuited
E07: AT sensor is open circuited
E08: AT sensor is short circuited
E09: Battery switch is in off position
E10: Compressor temperature is abnormal

(1) Temp. sensor

Open circuit (E01): When a temperature in temp. sensor is higher than 50℃, E01 and 50℃ are displayed alternately and audible alarm sounds intermittently and remote alarm contact activates.
Compressor is forced to run.
Press BUZZER key to silence audible alarm.

Short circuit (E02): When a temperature in temp. sensor is lower than -170℃, E02 and -170℃~ -180℃ are displayed alternately and audible alarm sounds intermittently and remote alarm contact activates.
Compressor is forced to run.
Press BUZZER key to silence audible alarm.

(2) Cascade sensor

Open circuit (E03): When a temperature in cascade sensor is higher than 60℃, E03 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact activates.
Both High and Low side compressors turn off.
Press BUZZER key to silence audible alarm.

Short circuit (E04): When a temperature in cascade sensor is lower than -65℃, E04 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact activates.
Both High and Low side compressor turn off.
Press BUZZER key to silence audible alarm.

(3) Filter sensor

Open circuit (E05): When a temperature in filter sensor is lower than -60℃, E05 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact activates.
High side compressor is forcibly turned off.
Press BUZZER key to silence audible alarm.

Short circuit (E06): When a temperature in filter sensor is higher than 60℃, E06 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact activates.
Press BUZZER key to silence audible alarm.

(4) AT sensor

Open circuit (E07): When a temperature in AT sensor is lower than -60℃, E07 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact activates.
Press BUZZER key to silence audible alarm.

Short circuit(E08): When a temperature in AT sensor is higher than 60℃, E08 and chamber temperature are displayed alternately, audible alarm sounds intermittently and remote alarm contact activates.
Press BUZZER key to silence audible alarm.

(5) Battery SW is in off position (E09): If you press ALARM TEST key when battery switch is in off position or battery is unconnected, E09 is displayed.

(6)Compressor abnormal temperature (E10): When a temperature in filter sensor is higher than 60℃, E10 and chamber temperature are displayed alternately and high side compressor is forced to turn off to notify compressor temperature is abnormal or fan motor is locked.
Press BUZZER key to silence audible alarm.
When the temperature in filter sensor subtracts ambient temperature is equal or lower than 10℃, compressor turns on.

(7) Error code priority

No.1: Cascade sensor error (E03, E04) … Compressor is forced to turn off
No.2: Filter sensor error (E05, E06) … Compressor protection is uncontrollable
No.3: Abnormal compressor temp.(E10) … Compressor temporary turns off
No.4: Temp. sensor error (E01, E02) … Compressor is forced to turn on
No.5: AT sensor error (E07, E08) … Warming-up operation is done with regardless of any ambient temp.

6. Warning function

Door alarm : When an outer door leaves open, DP54 (red lamp) illuminates. Audible alarm sounds intermittently after 1~15 minutes (Factory default: 2 minutes) elapse. Audible alarm does not activate simultaneously with remote alarm.
Press BUZZER key to silence audible alarm.(No Ring Back)

High temp. alarm : When chamber temperature is equal or higher than set temperature + high temp. alarm set temperature +1, ALARM lamp and LED blink, audible alarm sounds intermittently after 10 minutes delay, and remote alarm activates.
When chamber temperature is equal or lower than set temperature, ALARM lamp and LED go off, audible alarm silences, and remote alarm turns off.
When BUZZER key is pressed, audible alarm silences, but remote alarm output does not turn off.

Low temp. alarm : When chamber temperature is equal or lower than set temperature - low temp. alarm set temperature -1, ALARM lamp and LED blink, audible alarm sounds intermittently after 10 minutes delay, and remote alarm activates.
When chamber temperature is equal or higher than set temperature, ALARM lamp and LED go off, audible alarm silences, and remote alarm turns off.
When BUZZER key is pressed, audible alarm silences, but remote alarm output does not turn off.

Power failure alarm : If a power interrupts for 3 seconds when battery switch is in on-position, ALARM lamp blinks, audible alarm sounds intermittently and remote alarm activates.
When a power returns within 3 seconds after the power interrupts, microprocessor resets and unit will start operation in default settings. At the time remote alarm will be active.
Press BUZZER key to silence audible alarm, but remote alarm does not turn off.
Remote alarm should activate until chamber temperature is stable after the power returns from power failure.
When a power interrupts, press BUZZER key to see chamber temperature for 5 seconds.

7. Other function

Auto Return : If there are not any key operations for 90 seconds in setting mode, Key Lock mode and Function mode, unit automatically returns to chamber temperature display.

Ring Back : To prevent someone except for an operator pressing BUZZER key when a unit is in alarming condition, audible alarm sounds again after predetermined setting time elapses even if BUZZER key is pressed to silence audible alarm.

Display of sensor temperatures :
F12: Temperature in temp. sensor
(Ex. -80.2℃ → Displayed as '80.2')
F13: Temperature in cascade sensor
(Ex. 67℃ → Displayed as '067')
F14: Temperature in filter sensor
(Ex. 67℃ → Displayed as '067')
F15: Temperature in AT sensor
(Ex. 30℃ → Displayed as '030')

Battery accumulation time :
F03: Battery accumulation time is displayed.
(Ex. Accumulated 2years and 6months → Displayed as '02.5')
When '02.8' is shown on the display, BATTERY lamp illuminates to notify battery replacement.

<Reset of battery accumulation time>
Step to F06 and input '**409**'. Press SET key to change accumulation time to '00.0'. BATTERY lamp goes off.

Condensing fan motor accumulation time :
F32: Condensing fan motor accumulation time is displayed.
(Ex. Accumulated 5years and 6months → Displayed as '05.5')
When condensing fan motor accumulation time reaches to 5.6 years, BATTERY lamp blinks to notify fan motor replacement.

<Reset of battery accumulation time>
Step to F06 and input '**410**'. Press SET key to change accumulation time to '00.0'. BATTERY lamp goes off.

Capillary heater forcibly ON/OFF :
F18: When you input '000' in F18, compressor turns off and capillary heater is forced to turn on.
When you input '000' during capillary heater turns on, it comes to end to turn capillary heater on.
When you input '001', capillary heater never turns on, but compressor turns off in every 18 hours.

ROM version : F30: ROM version is displayed (Ex. Ver. 1.00 → Displayed as "1.00")

8. STATUS

(1) STATUS lamp illuminates in the following conditions;

STATUS 1: When an ambient temperature is higher than 35.0℃, or lower than 0℃, '----1' is displayed.
STATUS 2: When a power source voltage becomes low (Lower than 2.01VDC between TP7 and TP3), '--- 2' is displayed.
STATUS 3: When running rate is higher than 95%, '---3' is displayed.

(2) Display of STATUS code

(Ex.1) Every STATUS codes are displayed in the following order when all of three STATUS occur simultaneously.

' ------' => '--- 1' => '--- 2' => '--- 3' => '---1' …

(Ex. 2) Both STATUS codes are displayed in the following order when STATUS 1 and 2 occur simultaneously.

' ------' => '--- 1' => '--- 2' => '--- 2' => '---1' …

(Note)
When all of STATUS codes are eliminated or 90 seconds elapse, unit returns to chamber temperature display automatically.

9. Running rate

Running rate = (ON time / (ON time + OFF time)) x 100%

Condition to start measure running rate:
It regards as 'cycle start' when a compressor turns on after it turned off once chamber temperature was lower than set temperature.
Running rate should be measured after 2 hours elapse then.

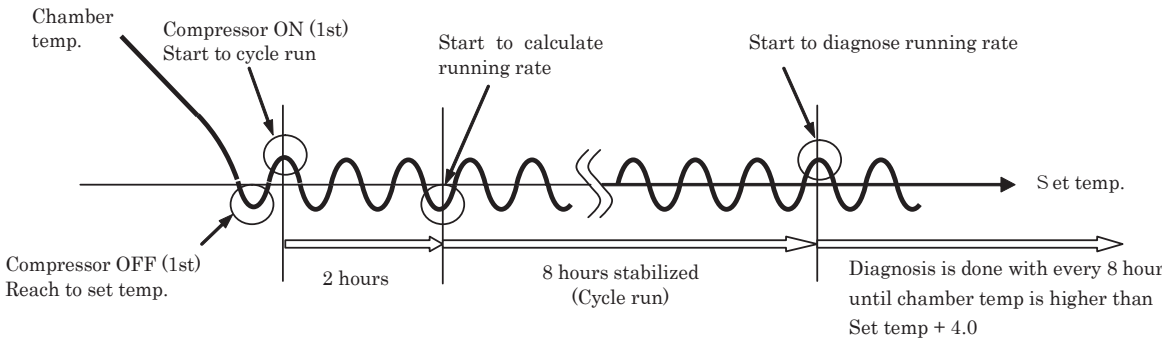
ON time (Min.) = The time until P3.1 in IC5 first reaches from LOW to HIGH
OFF time (Min.) = The time until P3.1 in IC5 reaches from HIGH to LOW

Condition to calculate running rate:

ON time	OFF time	Running rate
= 0	= 0	Impossible to calculate (0%)
> 0	= 0	
= 0	> 0	
> 0	> 0	0 ~ 100%

Note) Running rate cannot be measured when a chamber temperature is higher than set temperature + 4.0℃.
Wait until a chamber temperature is stabled.

Diagnosed value of overload running rate:
Step to F20 and input '000'.



Diagnosed running rate

=(-(Set temp.)X0.9)+((ATX0.9-4.5℃))-((Set temp.+85℃) / 10))

Running status will be obtained by calculating diagnosed running rate.

Unit determines by comparing running rate between 8 hours operation after 2 hours elapse after the unit commence cycle operation and diagnosed running rate.

(Diagnosed running rate – running rate) < 0 … Normal (DP52 goes off)

(Diagnosed running rate – running rate) ≧0 … Overload operation (DP52 illuminates)

222 = Running rate cannot be obtained by calculation. (DP52 goes off)

Diagnosis is done in every 8 hours.

10. Function mode

F00	Display of chamber temperature (Unused)
F01	Setting of high temperature alarm
F02	Setting of low temperature alarm
F03	Display of battery accumulation time
F04	Setting of door alarm delay time
F05	Setting of compressor delay time
F06	Setting of service code (Code: 384), Reset of accumulation time
F07 *	Temperature sensor Zero Adjustment
F08 *	Cascade sensor Zero Adjustment
F09	Compressor continuous running mode … Factory test mode (Unused)
F10	Program running mode … Factory test mode (Unused)
F11	PCB test mode … Factory test mode (Unused)
F12 *	Display of temperature in temp. sensor
F13 *	Display of temperature in cascade sensor
F14 *	Display of temperature in filter sensor
F15 *	Display of temperature in AT sensor
F16	Display of chamber temperature (Unused)
F17 *	Model code setting (Initialization of non-volatile ROM and memory)
F18 *	Capillary heater is forcibly turned on/off
F19	Setting of capillary heater ON time … Factory use
F20	Setting of diagnosed value of overload running rate … Factory use
F21	Communication ID set
F22	Communication mode set
F23 *	Display of power supply voltage
F24	Remote alarm terminal output
F25	Setting of Ring Back time
F26 *	Display of actual operation rate
F27 *	Display of diagnosed value of overload running rate
F28 *	Display of delay time of permission for measuring running rate (2 hrs timer)
F29 *	Display of delay time of permission for measuring running rate (8 hrs timer)
F30 *	ROM version is displayed
F31 *	Setting of filter alarm
F32	Display of condensing fan motor accumulation time
F33~F43	Unused
F44 *	Adjustment of display of power supply voltage
F45~F49	Unused
F50	Setting of alarm delay time
F51~F59	Unused

Input service code ‘384’ in F06 prior to use function codes which are marked with *.
To cancel service code, input “000” in F06 or turn the power off.

Setting procedure: In chamber temperature display, press ▲▲ key for 5 seconds to display “F00”.
Input Function code by pressing ▲▲ key and ▶▶ key.
Press SET key to be function mode available.

F00: <Purpose> Simply passing through if entered by mistake.
<Operation> Press SET key in “F00” to return to chamber temperature display.

F01: <Purpose> Setting of high temperature alarm
<Operation> Input F01 and press SET key to display “010” (Factory default).
Setting range is ‘005~020’.
Change a value by pressing ▲▲ key.
Press SET key to store the value and to return to chamber temperature display.

F02: <Purpose> Setting of low temperature alarm
<Operation> Input F02 and press SET key to display “-10” (Factory default).
Setting range is “-05”~“-20”. Change a value by pressing ▲▲ key.
Press SET key to store the value and to return to chamber temperature display.

F03: <Purpose> Display of battery accumulation time
<Operation> Input F03 and press SET key to display alternately F03 with “00.0” (in case battery used for 36days or less).
Press SET key to return to chamber temperature display.

F04: <Purpose> Setting of door alarm delay time
<Operation> Press SET key in “F04” to display ‘002’ (Factory default).
setting range is ‘001’~’015’.
Change a value by pressing ▲▲ key and ▶▶ key.
Press SET key to store the value and to return to chamber temperature display.

F05: <Purpose> Compressor turns on with delay when a power is supplied or a power returns from a power failure.
<Operation> Input “F05” and press SET key to display ‘003’ (Factory default).
Setting range is ‘003’~’015’. (Unit: Minute)
Change a value by pressing ▲▲ key and ▶▶ key.
Press SET key to store the value and to return to chamber temperature display.

F06: <Purpose> Input of service code. Reset of accumulation time
<Operation> Input F06 and press SET key to display ‘000’ (Factory default).
Set service code to “384” by pressing ▲▲ key and ▶▶ key.
Press SET key to store the value and to return to chamber temperature display.

<Reset of battery accumulation time>
Input service code ‘384’ in F06.
Input ‘409’ to reset battery accmulation time and to return to chamber temperature display. (Service code is cancelled)

<Reset of condensing fan motor accumulation time>
Input service code ‘384’ in F06.
Input ‘410’ to reset fan motor accumulation time and to return to chamber temperature display. (Service code is cancelled)

<Cancel> Input F06 again and press SET key to display '384'.
Change to '000' by pressing ⏫ key and ⏩ key.
Press SET key to store the value and to return to chamber temperature display.
Turn a power off then on to change a value to '000', but it is not stored in non-volatile memory.
Note) Service code '384' is stored in non-volatile memory during battery back-up.

F07: <Purpose> To match a temperature in temp. sensor with 1/2H air temperature
<Operation> Input service code in F06 prior to use this mode.
Input F07 and press SET key to display '00.0' (Factory default).
Setting range is '-4.9'~'04.9'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to store the value and to return to chamber temperature display.

F08: <Purpose> To calibrate a temperature in cascade sensor
<Operation> Input service code in F06 prior to use this mode.
Input F08 and press SET key to display '00.0' (Factory default).
Setting range is '-9.9'~'09.9'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to store the value and to return to chamber temperature display.

F12: <Purpose> To display a temperature in temp. sensor
<Operation> Input service code in F06 prior to use this mode.
Input F12 and press SET key to display alternately F12 and "XX.X" (chamber temperature). Press SET key to return to chamber temperature display. 3 digits indication. Minus "-" is not indicated.
Ex) "-79.5℃" → Indicated as "79.5"

F13: <Purpose> To display a temperature in cascade sensor
<Operation> Input service code in F06 prior to use this mode.
Input F13 and press SET key to display alternately F13 and "XX.X" (present temperature in cascade sensor). Press SET key to return to chamber temperature display.

F14: <Purpose> To display a temperature in filter sensor
<Operation> Input service code in F06 prior to use this mode.
Input F14 and press SET key to display alternately F14 and "XX.X" (present temperature in filter sensor). Press SET key to return to chamber temperature display.

F15: <Purpose> To display a temperature of AT sensor
<Operation> Input service code in F06 prior to use this mode.
Input F15 and press SET key to display alternately F15 and "XX.X" (present temperature in AT sensor). Press SET key to return to chamber temperature display.

F16: <Purpose> Simply passing through if entered by mistake.
<Operation> Press SET key in "F16" to return to chamber temperature display.

F17: <Purpose> Initialization of non-volatile memory. Model code change
<Operation> Service code should be input in F06 prior to use this mode.
Input F17 and press SET key to display '00X'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to store and return to chamber temperature display.
Model code '003': MDF-U74V/U74VC

<Initial values in non-volatile memory>

Zero Adjustment value for temperature sensor	: 0℃
Zero Adjustment value for cascade sensor	: 0℃
Capillary heater ON time	: 8 minutes
Auto Return	: 30 minutes
Chamber set temperature	: -80℃
Door alarm delay time	: 2 minutes
High temp. alarm	: +10℃
Low temp. alarm	: -10℃
Compressor delay time	: 3 minutes
Communication ID	: 000
Communication mode	: 000
Key Lock	: OFF
Linkage between remote alarm and buzzer	: OFF
Buzzer tone for filter alarm	: OFF
Diagnosed value for STATUS 3	: Fixed

F18: <Purpose> Setting of capillary heater ON/OFF time

<Operation> Service code should be input in F06 prior to use this mode.
Input F18 and Press SET key to display '000' (Factory default).
Change to alternative value '000' or '001' by press ⏫ key and ⏩ key.
Press SET key to store the value and return to chamber temperature display.
000: Capillary heater is forced to turn on when it turns off
Capillary heater is forced to turn off when it turns on
001: Capillary heater is not forced to operate

F21: <Purpose> Setting of serial communication ID

<Operation> Input F21 and press SET key to display '000' (Factory default).
Setting range is '001' ~ '255" by pressing ⏫ key and ⏩ key.
Press SET key to return to chamber temperature display.

<Serial communication data>

Chamber temperature	: 180.0 ~ +50.0 (℃)
Cascade temperature	: -68.0 ~ +89.0 (℃)
Power supply voltage	: 0.0 ~ 120.0 (%)
Filter temperature	: -68.0 ~ +160.0 (℃)
Ambient temperature	: -68.0 ~ +89.0 (℃)
Door status	: 0 / 100 (Close/Open)
Capillary heater status	: 0 / 100 (OFF/ON)
Compressor H status	: 0 / 100 (OFF/ON)
Compressor L status	: 0 / 100 (OFF/ON)
Power failure	: 0 / 100 (OFF/ON)
Running rate	: 0~100, 222 (%)
Diagnosed value for overload operation	: 0~100, 999 (%)
2H timer count	: 0~120 (Minutes)
8H timer count	: 0~480 (Minutes)
Chamber set temperature	: -90.0~-50.0 (℃)
Set temperature of high temp. alarm	: +5.0~+20.0 (℃)
Set temperature of low temp. alarm	: -5.0~-20.0 (℃)
FILTER lamp status	: 0 / 50 (OFF/ON)
Remote alarm status	: 0 / 50 (OFF/ON)
STATUS lamp status	: 0 / 50 (OFF/ON)
Chamber set temperature for remote mode	: -90.0~-50.0 (℃)

F22: <Purpose> Setting of serial communication mode
<Operation> input F22 and press SET key to display '000' (Factory default)
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and return to chamber temperature display.
Control mode (the 3rd digit)
0: Local (initial)
1: Remote
Baud rate (the 2nd digit)
0: 2400bps (initial)
1: 4800bps
2: 9600bps

Note) Setting value cannot be changed at control panel if control mode is set to 'Remote'.

F23: <Purpose> To display a power supply voltage (Unit: %)
<Operation> Service code should be input in F06 prior to use this mode.
Input F23 and press SET key to display alternately F23 with 'xxx' (present power supply voltage). Press SET key to return to chamber temperature display.

F24: <Purpose> Linkage between remote alarm and buzzer
<Operation> Input F24 and Press SET key to display '000' (Factory default).
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and return to chamber temperature display.
000: Remote alarm does not link with buzzer
001: Remote alarm links with buzzer

F25: <Purpose> Setting of Ring Back time
<Operation> Input F25 and press SET key to display "030" (Factory default).
Setting range is '000'~'060'.
Change a value by pressing ▲ key and ▶▶ key.
Press SET key to store the value and to return to chamber temperature display.

000: Not Ring Back
010: 10 minutes
020: 20 minutes
030: 30 minutes
040: 40 minutes
050: 50 minutes
060: 60 minutes

F26: <Purpose> Display of running rate (Unit: %)
<Operation> Service code should be input in F06 prior to use this mode.
Input F26 and press SET key to display alternately F26 with "XXX" (Present running rate).
Press SET key to return to chamber temperature display.

F27: <Purpose> Display of diagnosed value for overload running rate
<Operation> Service code should be input in F06 prior to use this mode.
Input F27 and press SET key to display alternately F27 with "XXX" (present diagnosed value of overload running rate).
'000' is displayed before it accumulates 480 minutes in 8H timer.
Factory default is '095' which is the fixed, except in case diagnosed value is obtained from calculation in F20.
Press SET key to return to chamber temperature display.

F28: <Purpose> Display of delay time to start measuring running rate
(2hrs timer; 000~120 min)
<Operation> Service code should be input in F06 prior to use this mode.
Input F28 and press SET key to display alternately F28 with 'xxx' (present count value for delay time to start measuring running rate).
Press SET key to return to chamber temperature display.
When a delay time expires (a value reaches to '120'), unit will start measuring running rate.

F29: <Purpose> Display of delay time to start diagnosing running rate
(8hrs timer; 000~480 min)
<Operation> Service code should be input in F06 prior to use this mode.
Input F29 and press SET key to display alternately F29 with 'xxx' (present count value for delay time to start diagnosing running rate).
Press SET key to return to chamber temperature display.
8hours timer start counting after 2hours timer expires.
When a delay time expires (a value reaches to '480'), unit will start diagnosing running rate.

F30: <Purpose> ROM version is displayed
<Operation> Service code should be input in F06 prior to use this mode.
Input F30 and press SET key to display alternately F30 with "X.XX" (present ROM version).
Press SET key to return to chamber temperature display.

F31: <Purpose> Setting of buzzer during filter alarm occurs
<Operation> Input F31 and press SET key to display "001" (Factory default).
Change to alternative value '000' or '001' by ⏫ key and ⏩ key.
Press SET key to revert to chamber temperature display.

000: Buzzer OFF
001: Buzzer ON

F32: <Purpose> Display of accumulation time of condensing fan motor
<Operation> Input F32 and press SET key to display alternately F32 with 'xx.x' (accumulation time).
Press SET key to return to chamber temperature display.

F44: <Purpose> Adjustment for difference of power supply voltage
<Operation> Input F44 and press SET key to display '000' (Factory default).
Setting range is '000'~'003'.
Press SET key to return to chamber temperature display.

Input value	Adjustment of display
000	0% (Power supply voltage is not increased)
001	3% increased
002	5% increased
003	7% increased

F50: <Purpose> Setting of alarm delay time
<Operation> Input F50 and press SET key to display '015' (Factory default).
Setting range is '000'~'015'.
Change a value by pressing ⏫ key and ⏩ key.
Press SET key to store the value and to return to chamber temperature display.

11. Compressor control (differential) value

Compressor H:

Turns on when a chamber temperature is set temperature -0.4℃.

Compressor L:

1) Turns on when compressor H turns on and a temperature in cascade sensor is -34℃.

2) Turns on after 3 minutes elapse since compressor H turned on

Compressor H, L:

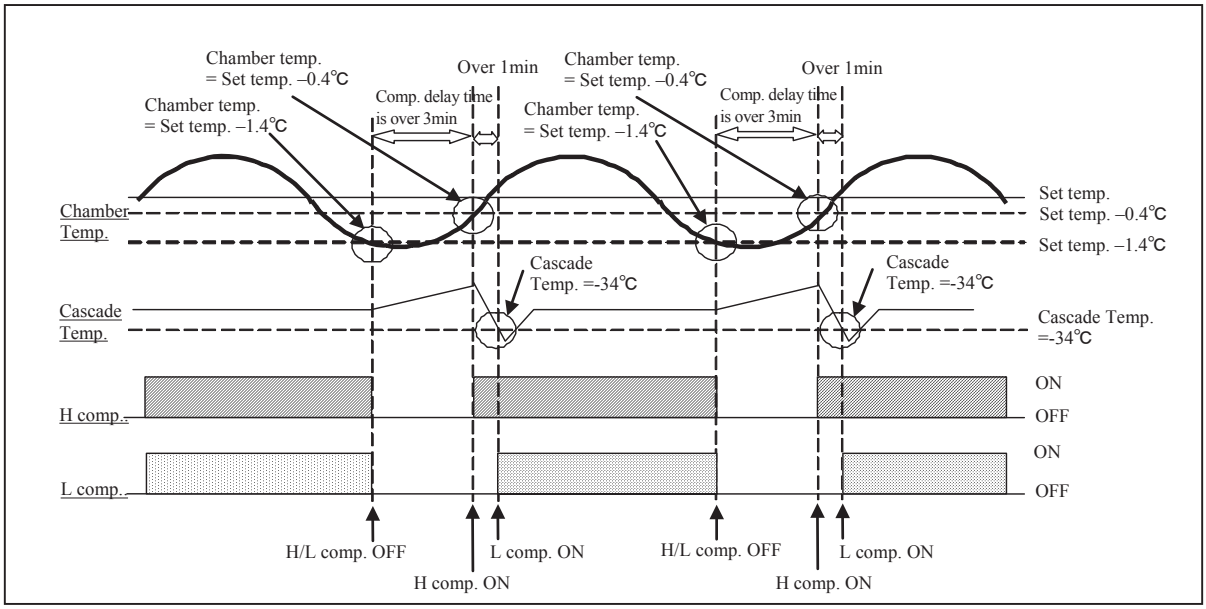
Turns off when a chamber temperature is set temperature -1.4℃

Interval:

1 minute *

* 'Interval' means that a period one of compressor either H or L turns on after another one was turned on.

Note) Compressor L does not turn on until 1 minute elapses after compressor H turned on, if a temperature in cascade sensor is lower than -34℃.



Compressor H protection:

Compressor H turns off to prevent it from being warmed up that is caused by fan motor locked.

Filter sensor temperature:

Compressor H turns off when a temperature in filter sensor is higher than 60℃. It will turn on again when the filter sensor temperature is lower than ambient temperature +10℃.

12. Delay time

Compressor delay time (Factory default: 3 minutes)

When a compressor H/L is turned off during cycle operation, it has a delay time to start the compressor again. Delay time can be set in F05.

Temperature alarm delay time (Factory default: 10 minutes)

When high or low temperature alarm is triggered, buzzer and remote alarm activate with the delay time. Delay time can be set in F01/F02.

* Note) ALARM lamp illuminates and indication is given without delay.

Door alarm delay time (Factory default: 2 minutes)

When an outer door is open, audible alarm sounds with the delay time.

Delay time can be set in F04.

Power failure alarm delay time (3 seconds fixed)
When a power is failed, power failure alarm is triggered with 3 seconds of delay.
Delay time cannot be changed.

13. Prevention for oil logging in capillary

Purpose:
Capillary heater which attached with capillary is powered by turning both High and Low side compressor off regularly to prevent oil logging in capillary.
Operation:
Both High and Low side compressor are turned off, while a capillary heater relay (CN4: 3-4) is turned on. DP3 (red lamp) is lit.
Frequency:
8 minutes in every 18 hours (Setting time are changeable in F19)
Timing of operation:
(1) 9 seconds after both High and Low side compressor are turned off during cycle operation.
(2) Both High and Low side compressor are forced to turn off if they keep running for 60 minutes or more after they were ordered to turn off.
Operation of capillary heater:
Capillary heater is forcibly ON/OFF controlled in F18.

14. Sensor offset

Offset value:
(1) Temperature sensor: +1.3℃ (Changeable in F07)
(2) Cascade sensor: +/-0.0℃ (Changeable in F08)
(3) Filter sensor: +/-0.0℃
(4) AT sensor: +/-0.0℃

15. Remote alarm terminal

Operation:
When an alarm is occurred, remote alarm contact (RLY2) switches the position.

	CN3	
	1 – 2 (N.O.)	1 – 3 (N.C.)
Normal	Open	Close
In alarm	Close	Open

16. Operation and setting after a power is reset

Settings when a power is supplied (Power on reset)
Alarms: OFF
Compressors: OFF
Remote alarm: OFF
Ring Back: 30 minutes
Door alarm delay time: 2 minutes
Timers: Reset
2H timer, 8H timer: 0 (Reset)
Counting of compressor L OFF period: Reset
Setting data: Read by non-volatile memory

Momentary power failure:
When a chamber temperature is lower than set temperature+10℃, unit will determine as 'Momentary power failure' is occurred.

Settings after unit returns from power failure:

Alarms: OFF
Compressors: OFF
Remote alarm: ON
Door alarm delay time: 2 minutes
Timers: Reset
2H timer, 8H timer: 0 (Reset)
Counting of compressor L OFF period: Reset
Setting data: Read by non-volatile memory

17. Lamp and display

Lamp operation:

<Control PCB>

DP1: Orange lamp
Goes off: High/low temp. alarm (15min. delay), sensor error, power failure
Illuminates: Not in alarm condition

DP2: Green lamp
Goes off: Compressor L turns off. (normal condition)
Illuminates: Compressor L turns on.

DP3: Red lamp
Goes off: Capillary heater turns off. (normal condition)
Illuminates: Capillary heater turns on.

DP4: Yellow lamp (Unused)

DP6: Green lamp
Goes off: Compressor H turns off. (normal condition)
Lit : Compressor H turns on.

<Display PCB>

DP51: Red lamp
Blinks : In alarm conditions

DP52: Green lamp
Illuminates : In STATUS mode

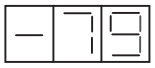
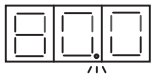
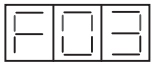
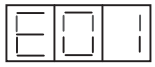
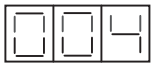
DP53: Orange lamp
Illuminates : In filter alarm

DP54: Red lamp
Illuminates : Door leaves open

DP55: Orange lamp
Illuminates : Battery accumulation time is reached to 2.8 years
Blinks : Fan motor accumulation time is reached to 5.6 years

DP56: Lock (Unused)

Examples of display:

Chamber temp. -79.5℃		Decimal point of chamber temp. -80.0	
Set temp. -80.0℃		Sensor offset -5.0	
Function F03		Operation monitoring LCP	
Service code 384		Error E01	
Set value 004		Accumulation time 8H timer 135	
Key Lock L_0			

Buzzer tone:

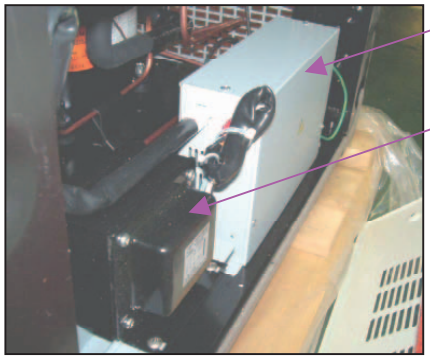
Alarms (except door alarm)	Intermittent tone
Key operation	Click tone
Set value memory	Click tone
Out of settable range	Continuous tone (1 second)
Door alarm	Intermittent tone with shorter than other alarms

Parts layout

Control panel

Latch "Close"

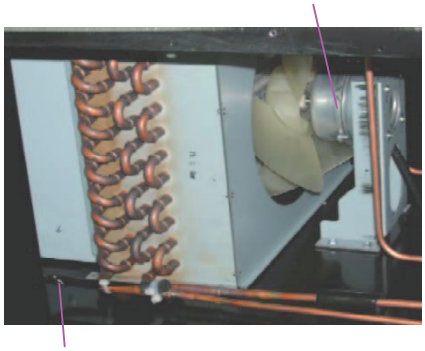
Latch "Open"



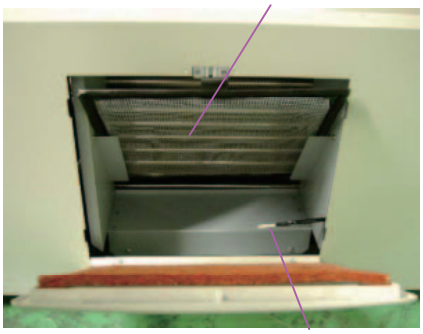
Boost BOX
(MDF-U74VC only)

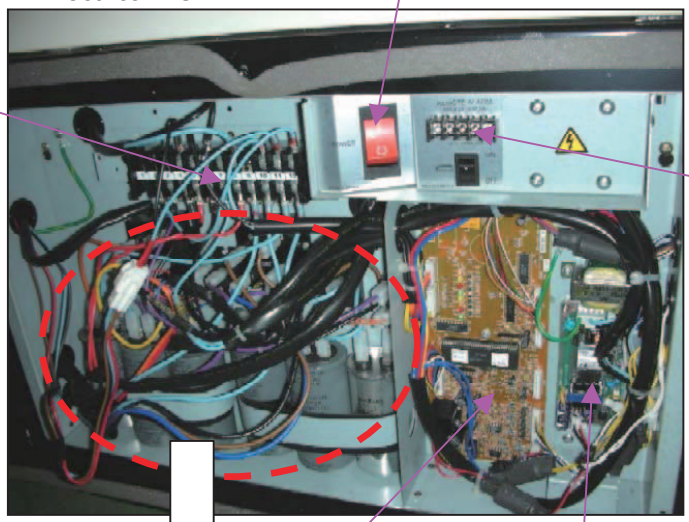
Power transformer
(MDF-U74VC only)

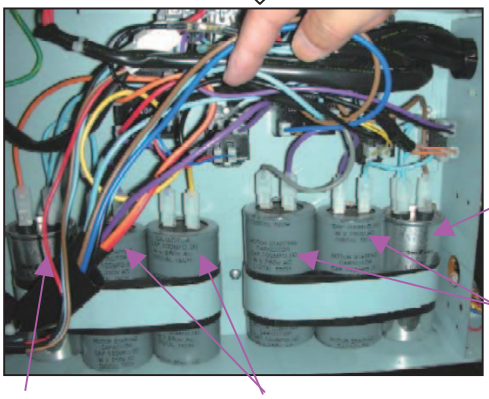
Fan motor



Filter sensor

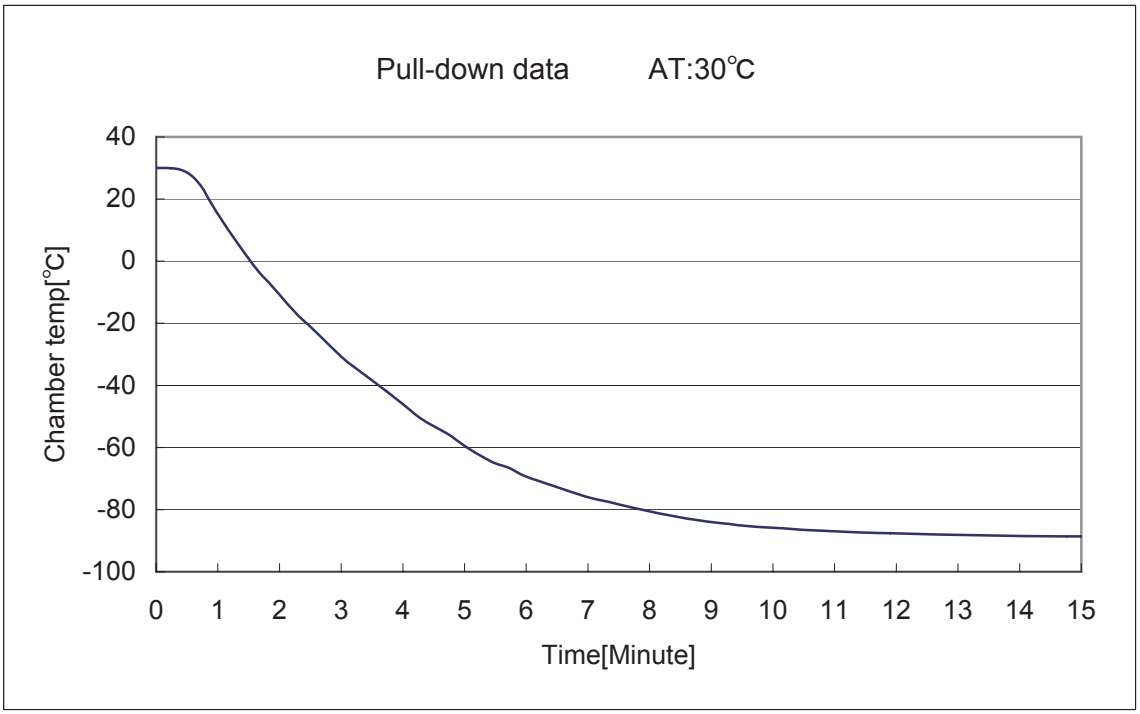

<Grille>
Filter
AT sensor

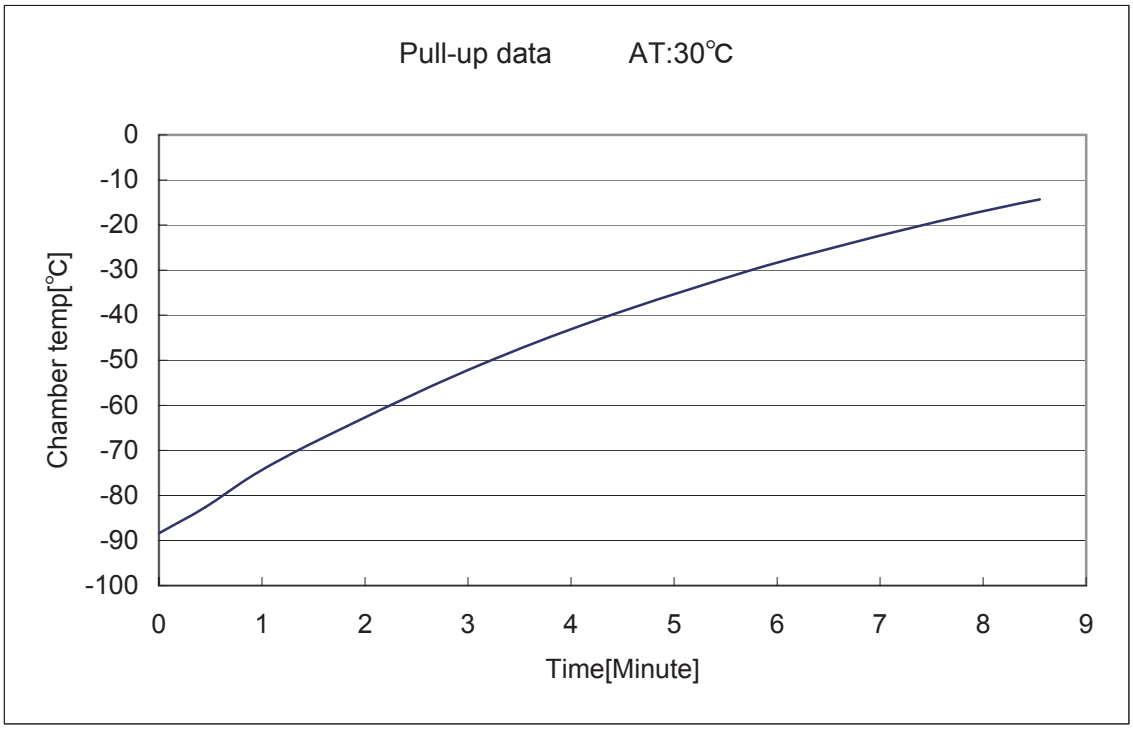

Power switch
<Electrical BOX>
12P terminal
Remote alarm
Main PCB
Switching power supply

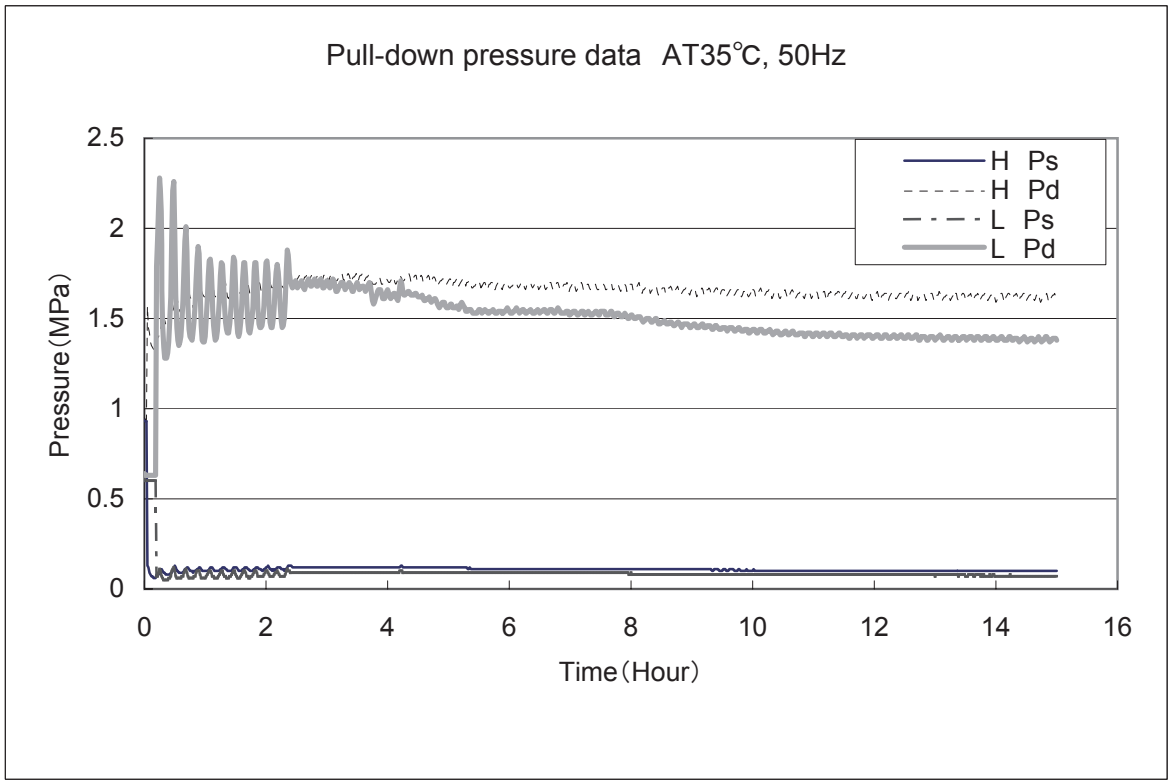

Running capacitor H
Starting capacitor H
Running capacitor L
Starting capacitor L

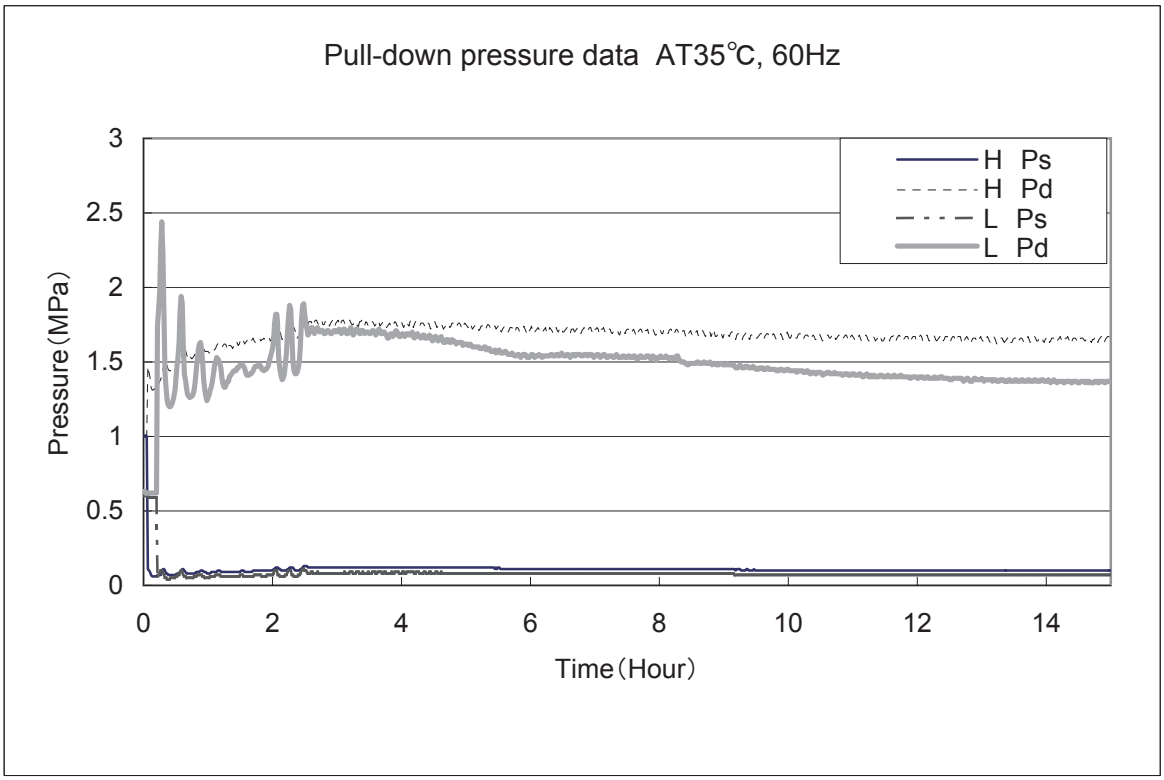
Test data

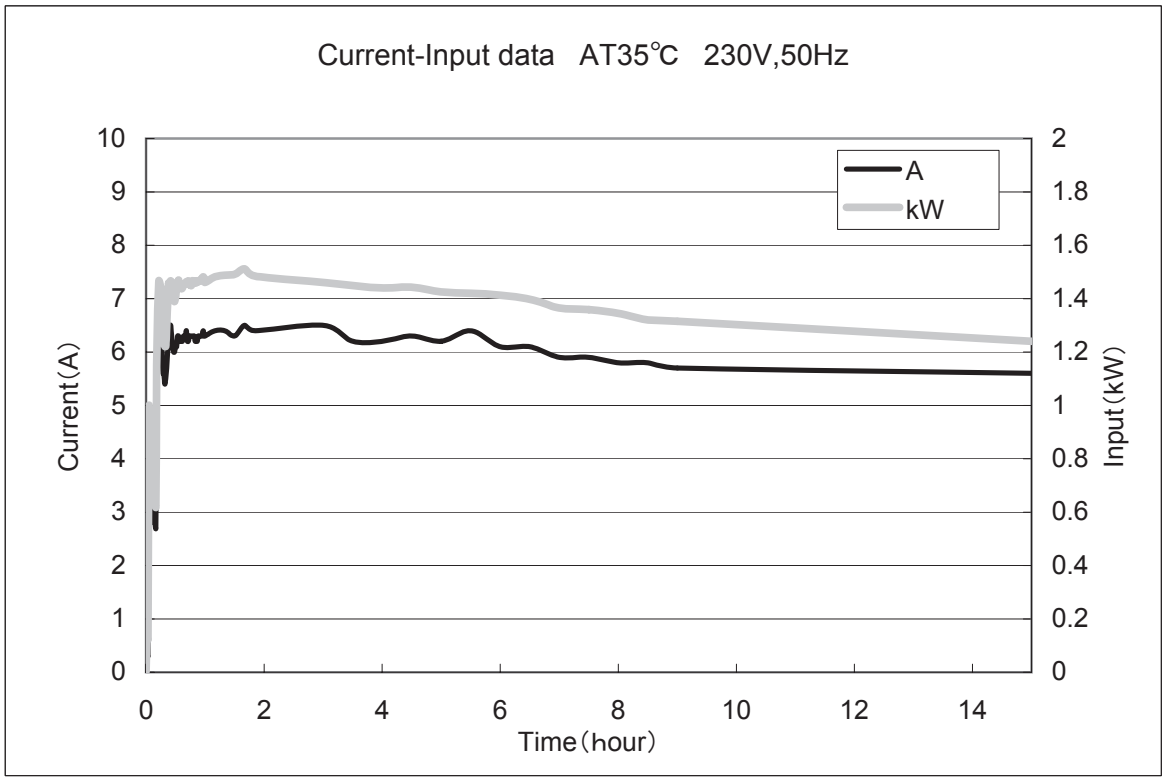
*Following data are the reference only.

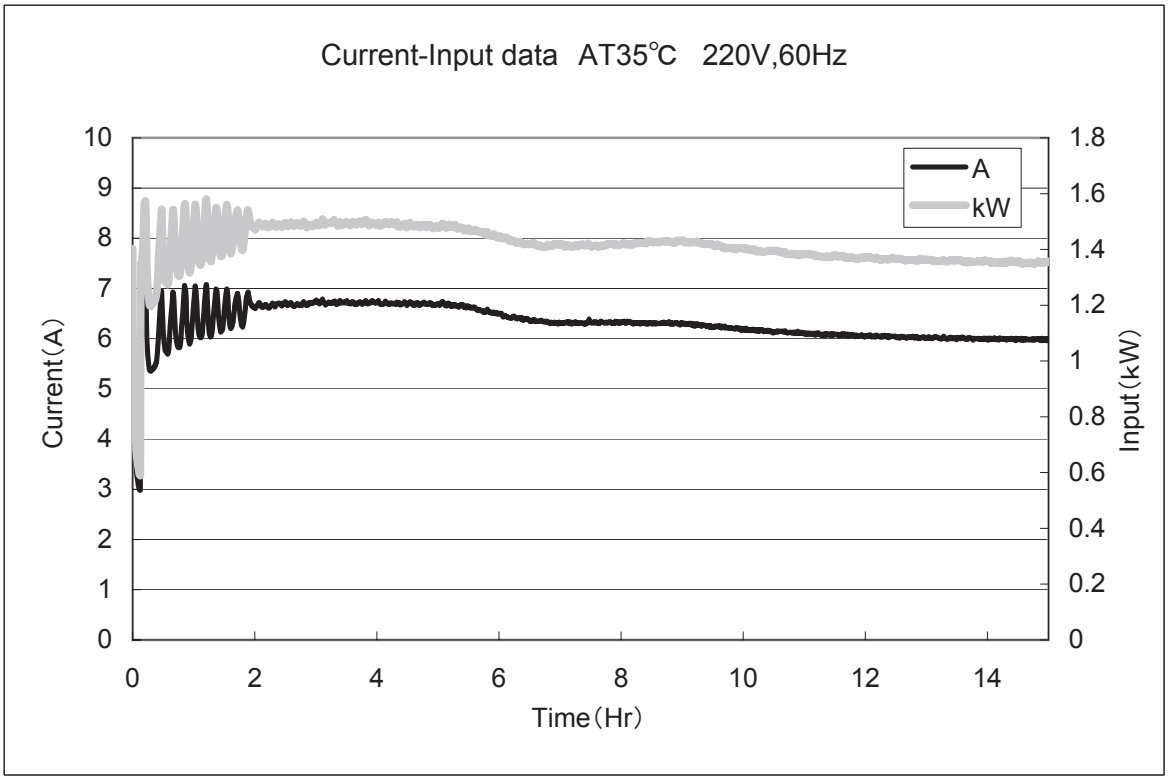


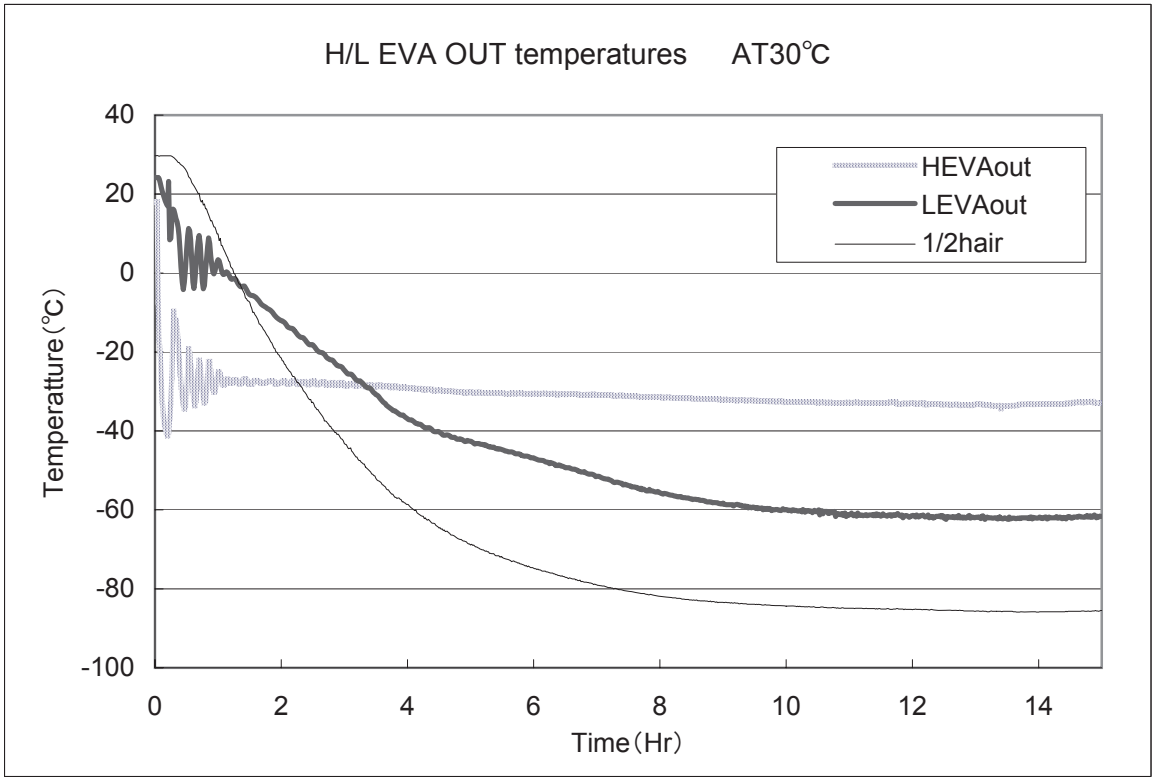



Pull-down pressure data AT35℃, 50Hz
Pressure (MPa)
Time (Hour)
H Ps
H Pd
L Ps
L Pd
0
0.5
1
1.5
2
2.5
0
2
4
6
8
10
12
14
16


Pull-down pressure data AT35℃, 60Hz
Pressure (MPa)
Time (Hour)
H Ps
H Pd
L Ps
L Pd
0
0.5
1
1.5
2
2.5
3
0
2
4
6
8
10
12
14

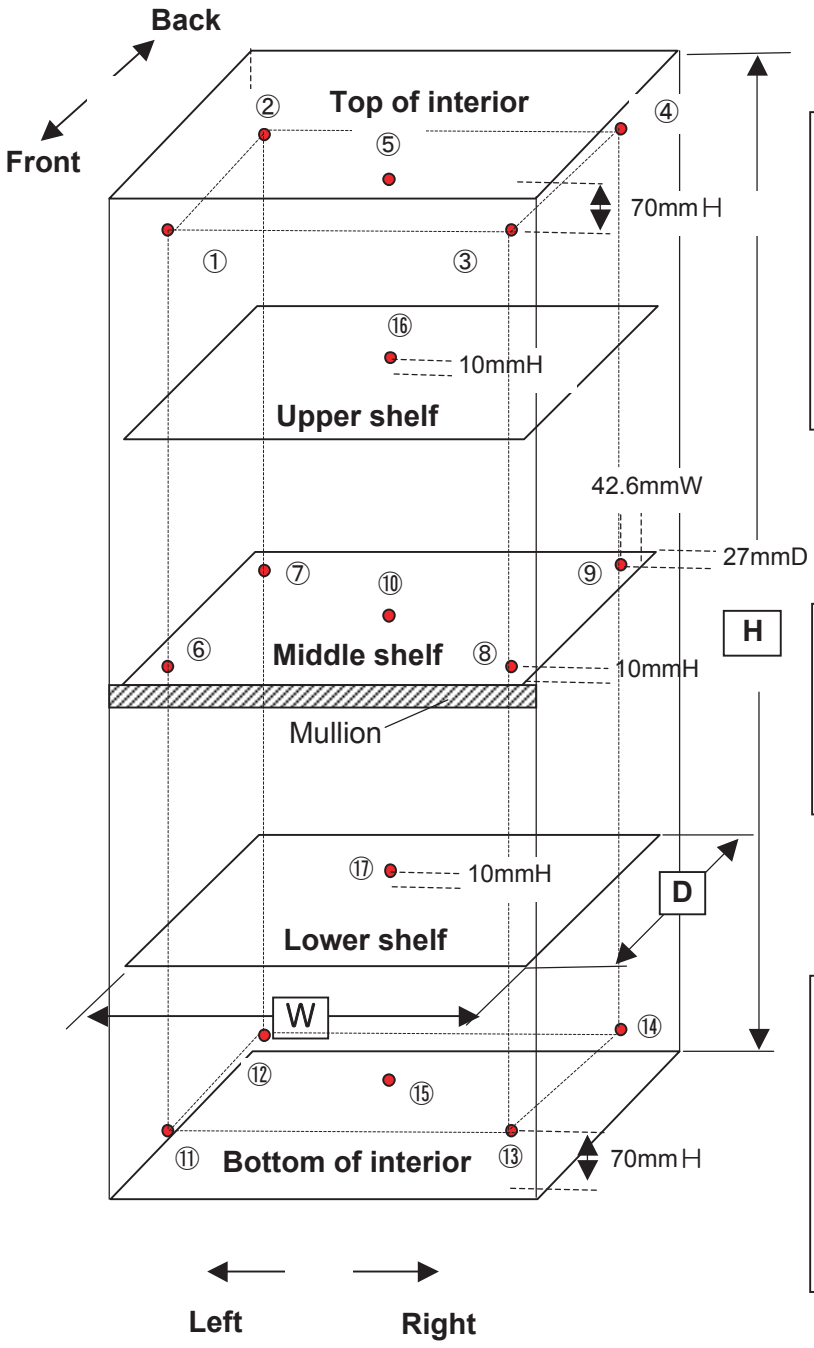

Current-Input data AT35℃ 230V,50Hz
A
kW
Current(A)
Input(kW)
Time(hour)
0
1
2
3
4
5
6
7
8
9
10
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
0
2
4
6
8
10
12
14


Current-Input data AT35℃ 220V,60Hz
A
kW
Current(A)
Input(kW)
Time(Hr)
0
1
2
3
4
5
6
7
8
9
10
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
0
2
4
6
8
10
12
14


H/L EVA OUT temperatures AT30℃
HEVAout
LEVAout
1/2hair
Temperatture（℃）
Time（Hr）
40
20
0
-20
-40
-60
-80
-100
0
2
4
6
8
10
12
14

Temperature uniformity - 17 points measured

* Measured points



Upper area measuring points

①~④: 70mm(H) from top of interior
27mm(D), 42.6mm(W) from each corners on Middle shelf.

⑤: 65mm(H) from top of interior

⑯: 10mm(H) from upper shelf

Middle area measuring points

⑥~⑨: 10mm(H), 27mm(D), 42.6mm(W) from each corner on middle shelf

⑩: 10mm(H) from middle shelf

Bottom area measuring points

⑪~⑭: 70mm(H) from bottom of interior
27mm(D), 42.6mm(W) from each corner on middle shelf

⑮ 65mm(H) from bottom of interior

⑰: 10mm(H) from lower shelf

＜Conditions＞

Ambient temperature: 20/30℃
Load: Unloaded

＜Distribution data＞
Temperature of the cycle in each area (SV=-80℃、air temperature)

Unit:℃

			Ambient temperature 20℃							
			50Hz				60Hz			
			Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-75.9	-79.1	-77.5	±1.6	-74.3	-80.5	-77.4	±3.1
②		Left back	-76.6	-79.9	-78.3	±1.7	-74.3	-81.9	-78.1	±3.8
③		Right front	-75.8	-79.5	-77.7	±1.9	-74.1	-81.6	-77.9	±3.8
④		Right back	-76.6	-80.9	-78.8	±2.2	-75.1	-82.1	-78.6	±3.5
⑤		Center	-77.2	-81.2	-79.2	±2.0	-75.2	-83.2	-79.2	±4.0
⑥	Middle area	Left front	-77.1	-79.6	-78.4	±1.3	-76.3	-80.3	-78.3	±2.0
⑦		Left back	-78.2	-81.2	-79.7	±1.5	-76.0	-83.3	-79.7	±3.7
⑧		Right front	-76.8	-79.2	-78.0	±1.2	-75.0	-81.0	-78.0	±3.0
⑨		Right back	-79.5	-82.4	-81.0	±1.5	-78.8	-83.8	-81.3	±2.5
⑩		Center	-77.2	-79.5	-78.4	±1.2	-75.3	-81.6	-78.5	±3.2
⑪	Bottom area	Left front	-73.2	-75.5	-74.4	±1.2	-72.3	-77.3	-74.8	±2.5
⑫		Left back	-74.8	-76.7	-75.8	±1.0	-73.6	-78.6	-76.1	±2.5
⑬		Right front	-72.6	-75.4	-74.0	±1.4	-71.7	-76.2	-74.0	±2.3
⑭		Right back	-74.2	-76.4	-75.3	±1.1	-72.8	-77.7	-75.3	±2.5
⑮		Center	-74.1	-75.9	-75.0	±0.9	-73.2	-77.8	-75.5	±2.3
⑯	Center of Upper shelf		-79.8	-82.3	-81.1	±1.3	-77.6	-84.0	-80.8	±3.2
⑰	Center of Lower shelf		-75.0	-77.5	-76.3	±1.3	-73.9	-78.2	-76.1	±2.2
Average			-	-	-77.6	-	-	-	-77.6	-

Unit:℃

			Ambient temperature 30℃							
			50Hz				60Hz			
			Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-74.8	-78.0	-76.4	±1.6	-75.1	-78.6	-76.9	±1.8
②		Left back	-75.4	-78.6	-77.0	±1.6	-75.6	-79.6	-77.6	±2.0
③		Right front	-74.6	-78.3	-76.5	±1.9	-74.8	-78.9	-76.9	±2.1
④		Right back	-75.4	-79.6	-77.5	±2.1	-75.7	-80.6	-78.2	±2.5
⑤		Center	-75.9	-80.0	-78.0	±2.1	-75.9	-80.5	-78.2	±2.3
⑥	Middle area	Left front	-76.4	-79.0	-77.7	±1.3	-76.3	-79.2	-77.8	±1.5
⑦		Left back	-77.5	-80.5	-79.0	±1.5	-77.3	-81.1	-79.2	±1.9
⑧		Right front	-76.0	-78.8	-77.4	±1.4	-76.3	-79.6	-78.0	±1.7
⑨		Right back	-78.9	-82.1	-80.5	±1.6	-79.0	-82.5	-80.8	±1.8
⑩		Center	-76.6	-79.0	-77.8	±1.2	-76.5	-79.2	-77.9	±1.4
⑪	Bottom area	Left front	-73.5	-75.5	-74.5	±1.0	-72.6	-75.1	-73.9	±1.3
⑫		Left back	-74.4	-76.5	-75.5	±1.1	-73.1	-76.4	-74.8	±1.7
⑬		Right front	-72.3	-74.5	-73.4	±1.1	-73.0	-75.1	-74.1	±1.1
⑭		Right back	-74.1	-76.4	-75.3	±1.2	-74.3	-76.9	-75.6	±1.3
⑮		Center	-73.9	-76.0	-75.0	±1.1	-73.8	-76.3	-75.1	±1.3
⑯	Center of Upper shelf		-78.9	-81.6	-80.3	±1.3	-79.0	-82.0	-80.5	±1.5
⑰	Center of Lower shelf		-74.6	-77.3	-76.0	±1.4	-74.1	-77.4	-75.8	±1.7
Average			-	-	-76.9	-	-	-	-77.1	-

＜Amount of power consumption＞

Amount of power consumption when driving at cycle
(SV=-80℃)

Unit：kWh/day

	Ambient temperature 20℃		Ambient temperature 30℃	
	50Hz	60Hz	50Hz	60Hz
220V	18.06	20.73	20.53	23.57
230V	18.47	-	21.00	-
240V	18.69	-	21.25	-

Note:This data does not represent a guarantee
of product performance.

＜Distribution data＞
Temperature of the cycle in each area (SV=-70℃、air temperature

Unit:℃

			Ambient temperature 20℃							
			50Hz				60Hz			
			Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-67.9	-72.9	-70.4	±2.5	-68.1	-73.3	-70.7	±2.6
②		Left back	-68.5	-74.4	-71.5	±3.0	-68.8	-74.9	-71.9	±3.1
③		Right front	-68.0	-74.1	-71.1	±3.1	-68.3	-74.5	-71.4	±3.1
④		Right back	-68.9	-76.0	-72.5	±3.6	-69.3	-76.7	-73.0	±3.7
⑤		Center	-69.4	-76.0	-72.7	±3.3	-69.7	-76.6	-73.2	±3.5
⑥	Middle area	Left front	-67.7	-71.1	-69.4	±1.7	-68.0	-71.1	-69.6	±1.6
⑦		Left back	-68.8	-74.5	-71.7	±2.9	-69.8	-74.4	-72.1	±2.3
⑧		Right front	-67.9	-71.5	-69.7	±1.8	-68.3	-71.6	-70.0	±1.7
⑨		Right back	-70.9	-75.5	-73.2	±2.3	-71.0	-75.5	-73.3	±2.3
⑩		Center	-68.6	-72.3	-70.5	±1.9	-68.8	-72.2	-70.5	±1.7
⑪	Bottom area	Left front	-63.2	-65.2	-64.2	±1.0	-63.2	-65.0	-64.1	±0.9
⑫		Left back	-63.1	-66.8	-65.0	±1.9	-64.0	-66.8	-65.4	±1.4
⑬		Right front	-63.3	-65.6	-64.5	±1.2	-63.3	-65.4	-64.4	±1.1
⑭		Right back	-64.8	-67.2	-66.0	±1.2	-64.9	-67.2	-66.1	±1.2
⑮		Center	-64.0	-66.2	-65.1	±1.1	-64.2	-66.0	-65.1	±0.9
⑯	Center of Upper shelf		-71.9	-76.0	-74.0	±2.1	-72.3	-76.2	-74.3	±2.0
⑰	Center of Lower shelf		-64.9	-67.5	-66.2	±1.3	-65.0	-67.4	-66.2	±1.2
Average			-	-	-69.1	-	-	-	-69.4	-

Unit:℃

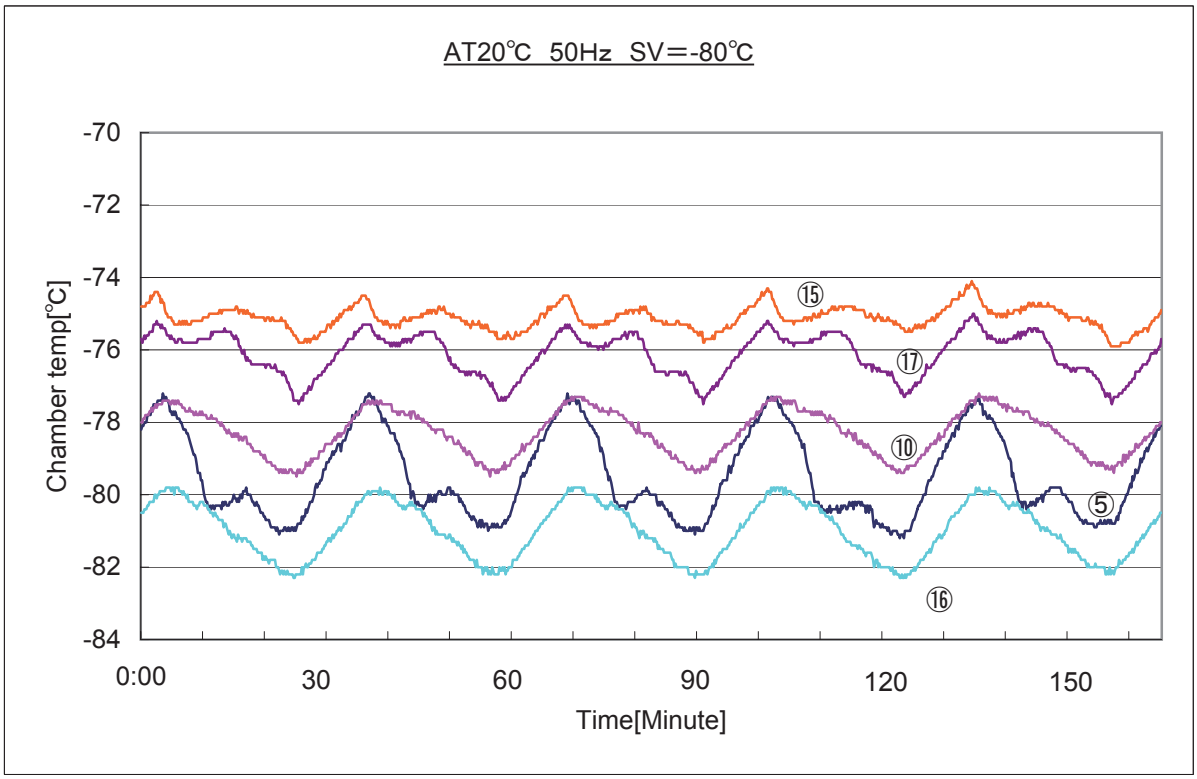
			Ambient temperature 30℃							
			50Hz				60Hz			
			Maximum	Minimum	Middle of cycle	Differential	Maximum	Minimum	Middle of cycle	Differential
①	Upper area	Left front	-67.8	-72.7	-70.3	±2.5	-67.7	-73.3	-70.5	±2.8
②		Left back	-68.6	-73.9	-71.3	±2.7	-68.7	-74.4	-71.6	±2.9
③		Right front	-67.6	-73.7	-70.7	±3.1	-67.5	-74.1	-70.8	±3.3
④		Right back	-68.2	-75.4	-71.8	±3.6	-68.2	-75.7	-72.0	±3.8
⑤		Center	-69.1	-75.5	-72.3	±3.2	-69.1	-75.9	-72.5	±3.4
⑥	Middle area	Left front	-67.5	-71.6	-69.6	±2.1	-67.6	-71.6	-69.6	±2.0
⑦		Left back	-69.6	-74.7	-72.2	±2.6	-69.8	-75.2	-72.5	±2.7
⑧		Right front	-67.1	-71.1	-69.1	±2.0	-66.9	-71.3	-69.1	±2.2
⑨		Right back	-70.5	-75.9	-73.2	±2.7	-70.4	-76.0	-73.2	±2.8
⑩		Center	-68.4	-72.4	-70.4	±2.0	-68.4	-72.8	-70.6	±2.2
⑪	Bottom area	Left front	-62.8	-64.8	-63.8	±1.0	-62.7	-65.1	-63.9	±1.2
⑫		Left back	-64.1	-66.4	-65.3	±1.2	-63.8	-66.6	-65.2	±1.4
⑬		Right front	-61.7	-63.6	-62.7	±0.9	-61.5	-63.6	-62.6	±1.1
⑭		Right back	-63.3	-65.8	-64.6	±1.3	-63.2	-66.0	-64.6	±1.4
⑮		Center	-63.0	-65.0	-64.0	±1.0	-62.8	-65.1	-64.0	±1.2
⑯	Center of Upper shelf		-72.0	-76.6	-74.3	±2.3	-72.1	-76.6	-74.4	±2.3
⑰	Center of Lower shelf		-64.2	-66.8	-65.5	±1.3	-64.1	-66.9	-65.5	±1.4
Average			-	-	-68.9	-	-	-	-69.0	-

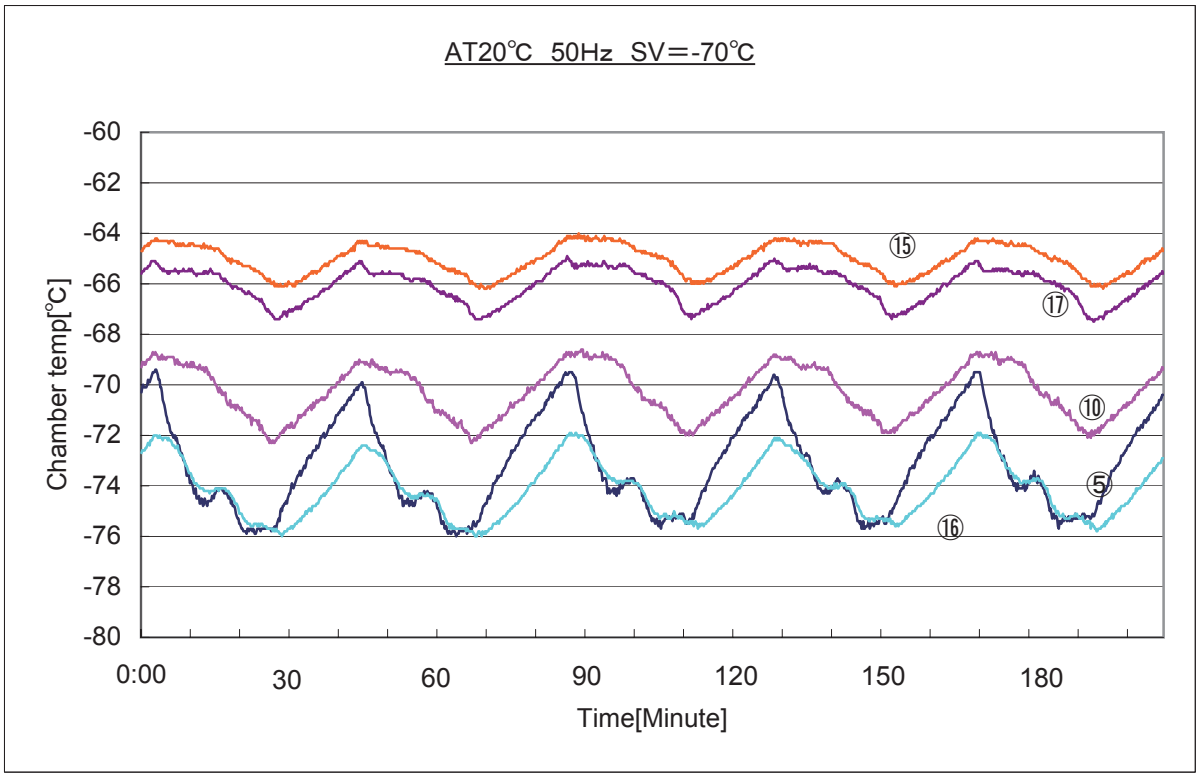
＜Amount of power consumption＞
Amount of power consumption when driving at cycle
(SV=-70℃)

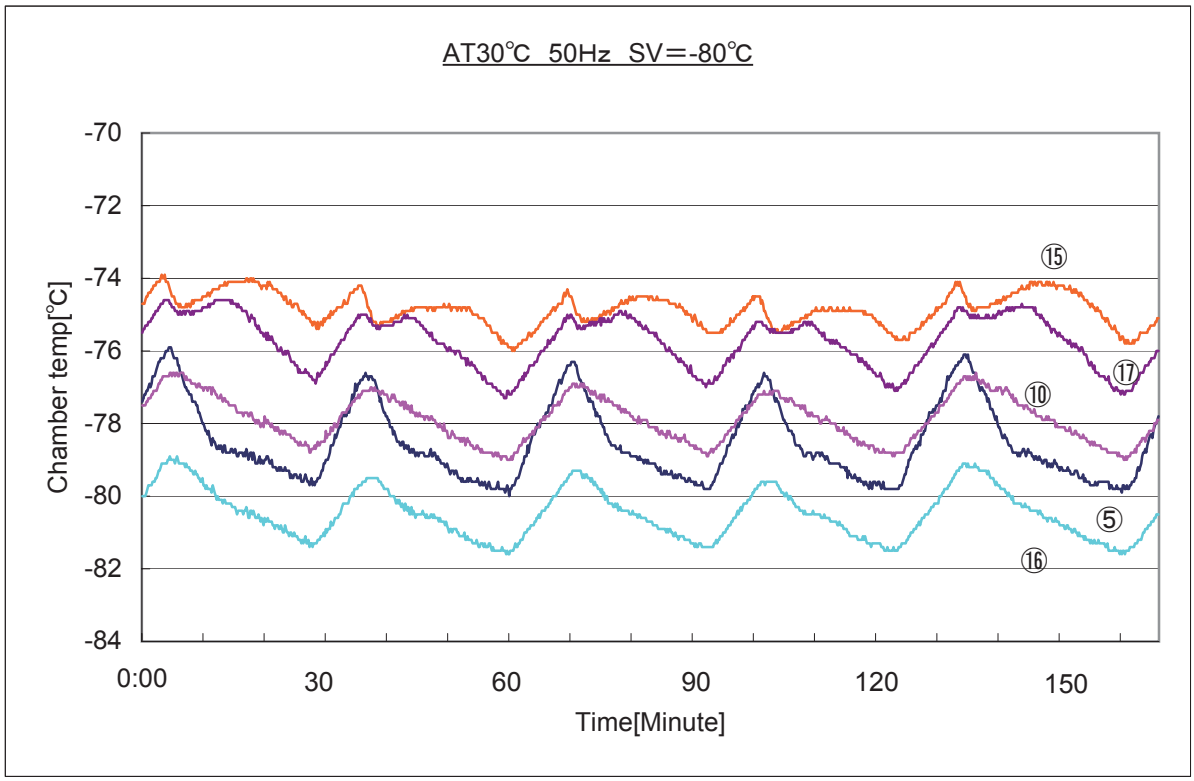
Unit：kWh/day

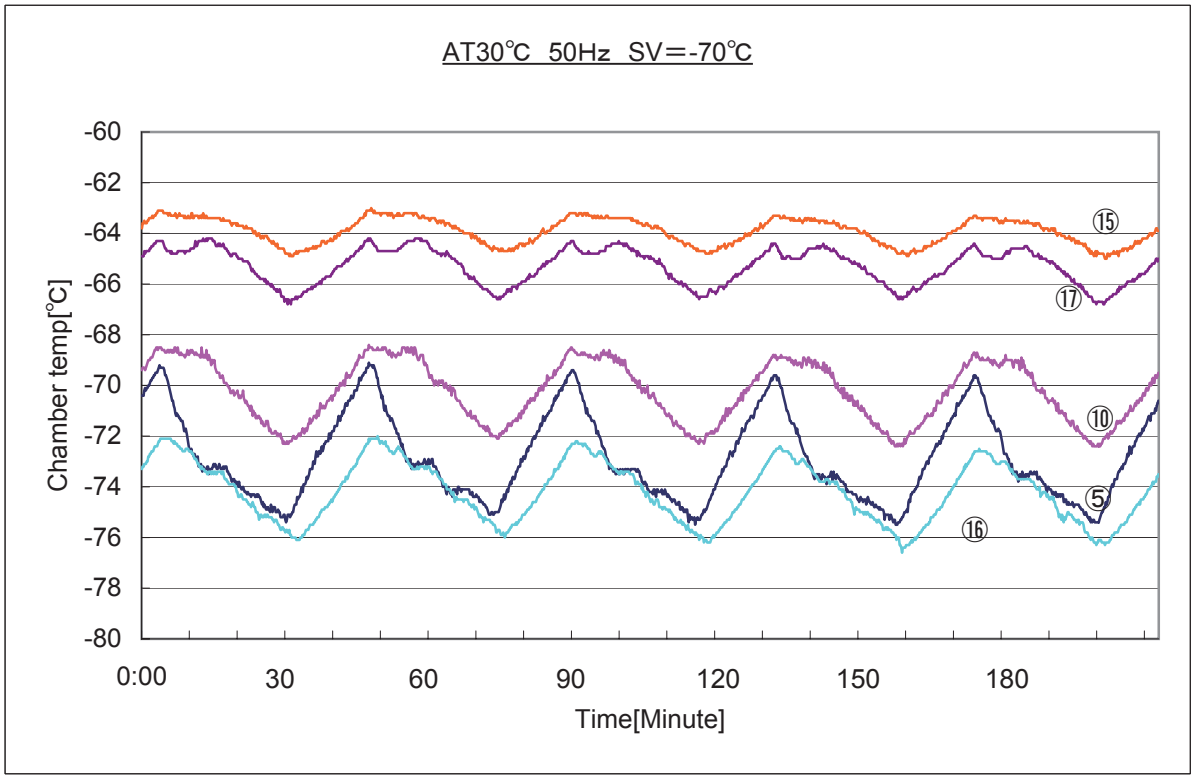
	Ambient temperature 20℃		Ambient temperature 30℃	
	50Hz	60Hz	50Hz	60Hz
220V	15.23	17.71	17.81	20.28
230V	15.58	-	17.84	-
240V	15.97	-	18.93	-

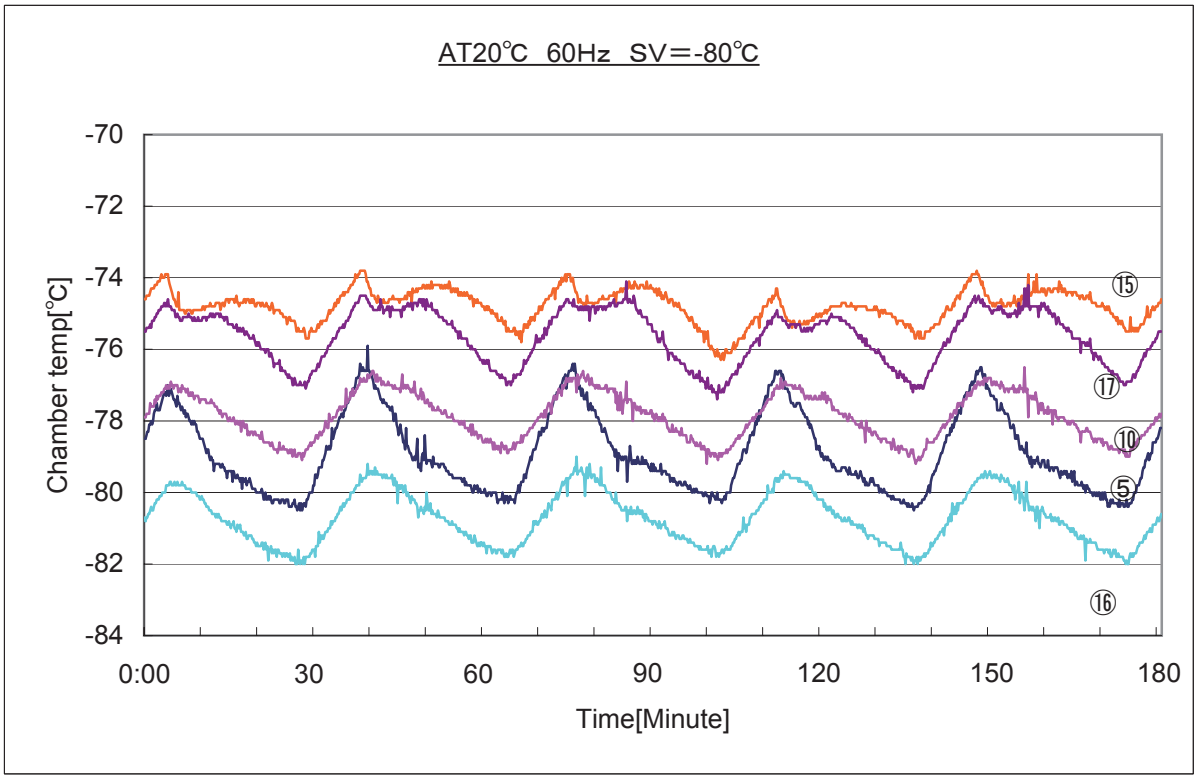
Note:This data does not represent a guarantee of product performance.

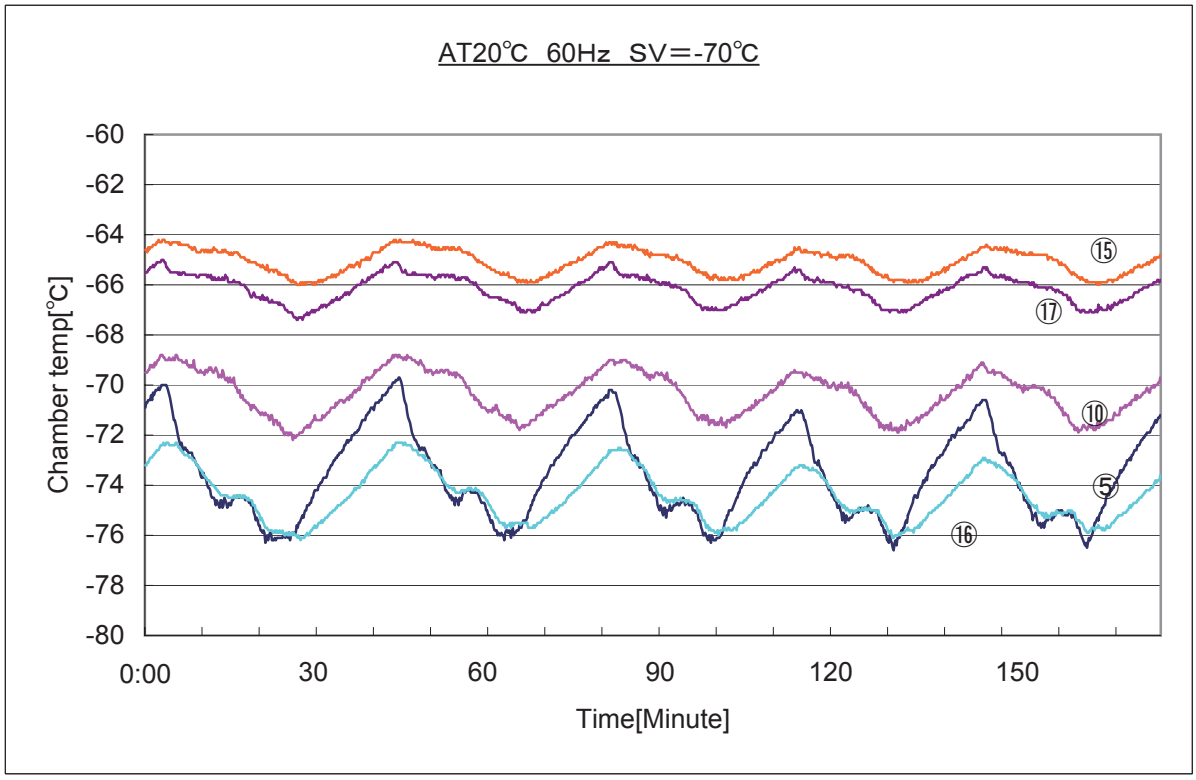

AT20℃ 50Hz SV=-80℃
-70
-72
-74
-76
-78
-80
-82
-84
Chamber temp[℃]
0:00
30
60
90
120
150
Time[Minute]
⑮
⑰
⑩
⑤
⑯

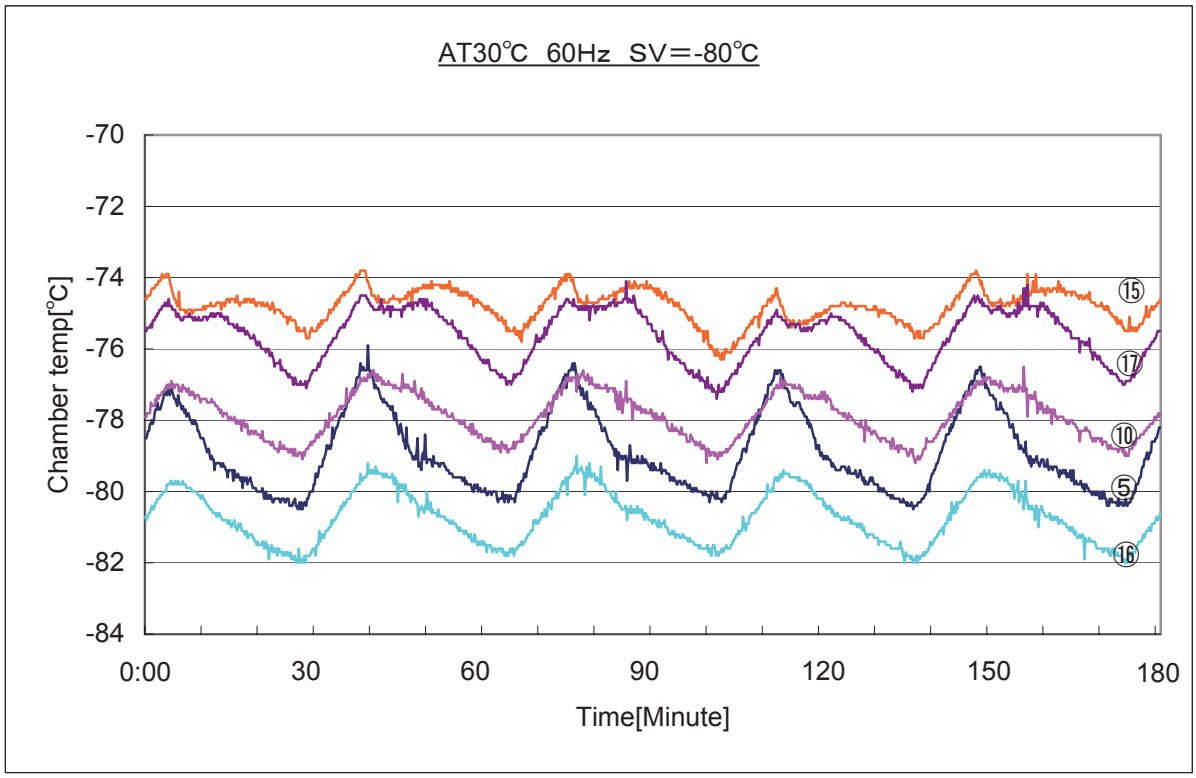

AT20℃ 50Hz SV=-70℃
-60
-62
-64
-66
-68
-70
-72
-74
-76
-78
-80
Chamber temp[℃]
0:00
30
60
90
120
150
180
Time[Minute]
⑮
⑰
⑩
⑤
⑯

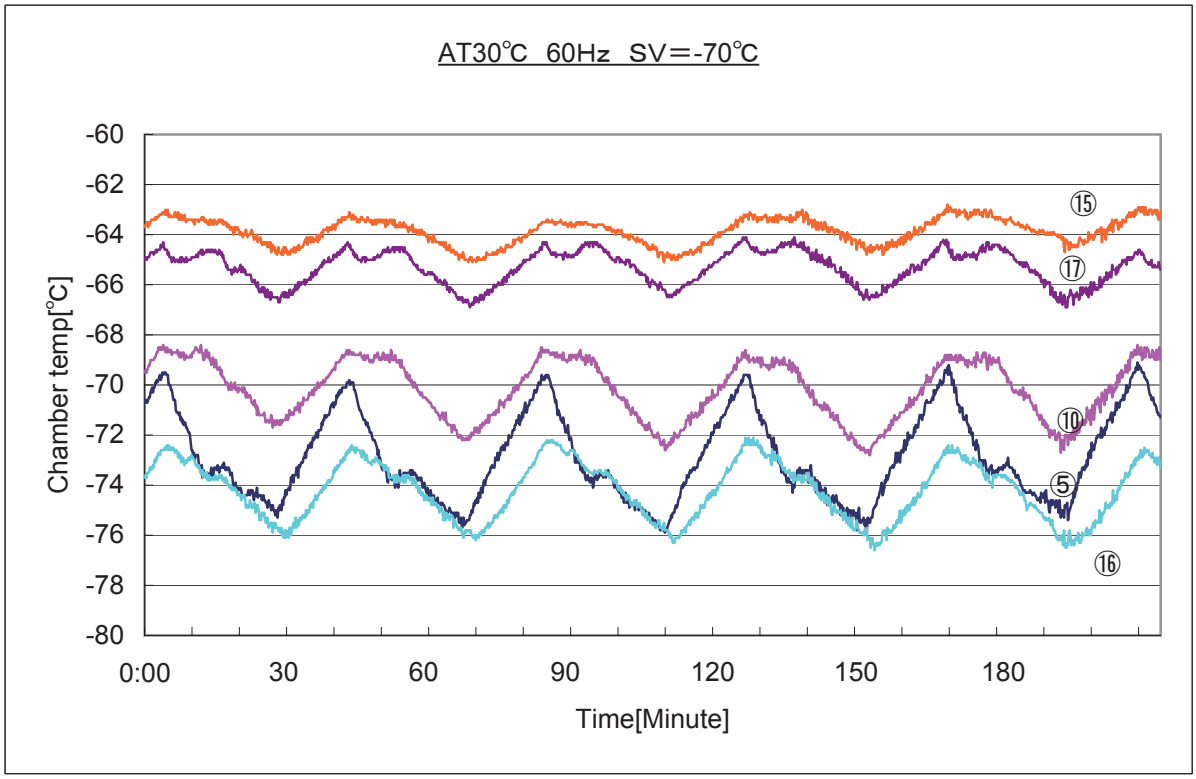

AT30℃ 50Hz SV=-80℃
-70
-72
-74
-76
-78
-80
-82
-84
Chamber temp[℃]
0:00
30
60
90
120
150
Time[Minute]
⑮
⑰
⑩
⑤
⑯


AT30℃ 50Hz SV=-70℃
-60
-62
-64
-66
-68
-70
-72
-74
-76
-78
-80
Chamber temp[℃]
0:00
30
60
90
120
150
180
Time[Minute]
⑮
⑰
⑩
⑤
⑯


AT20℃ 60Hz SV=-80℃
-70
-72
-74
-76
-78
-80
-82
-84
Chamber temp[℃]
0:00
30
60
90
120
150
180
Time[Minute]
⑮
⑰
⑩
⑤
⑯


AT20℃ 60Hz SV=-70℃
-60
-62
-64
-66
-68
-70
-72
-74
-76
-78
-80
Chamber temp[℃]
0:00
30
60
90
120
150
Time[Minute]
⑮
⑰
⑩
⑤
⑯

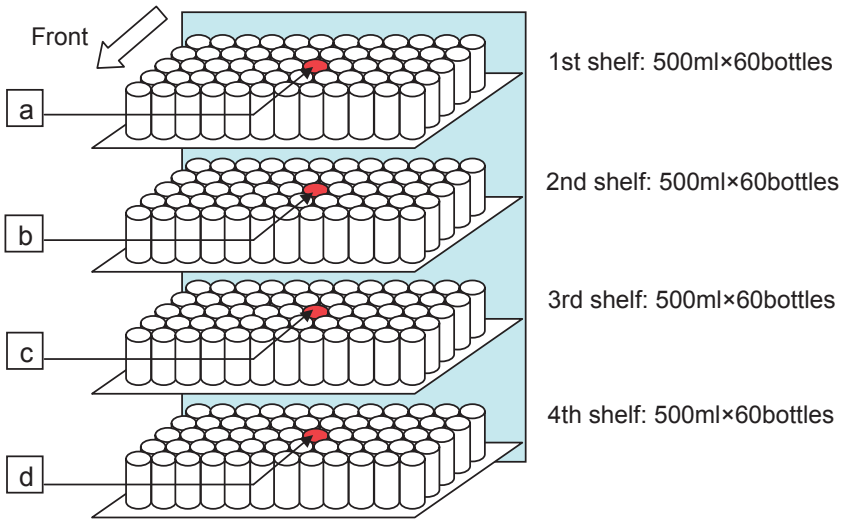

AT30℃ 60Hz SV=-80℃
-70
-72
-74
-76
-78
-80
-82
-84
Chamber temp[℃]
0:00
30
60
90
120
150
180
Time[Minute]
⑮
⑰
⑩
⑤
⑯

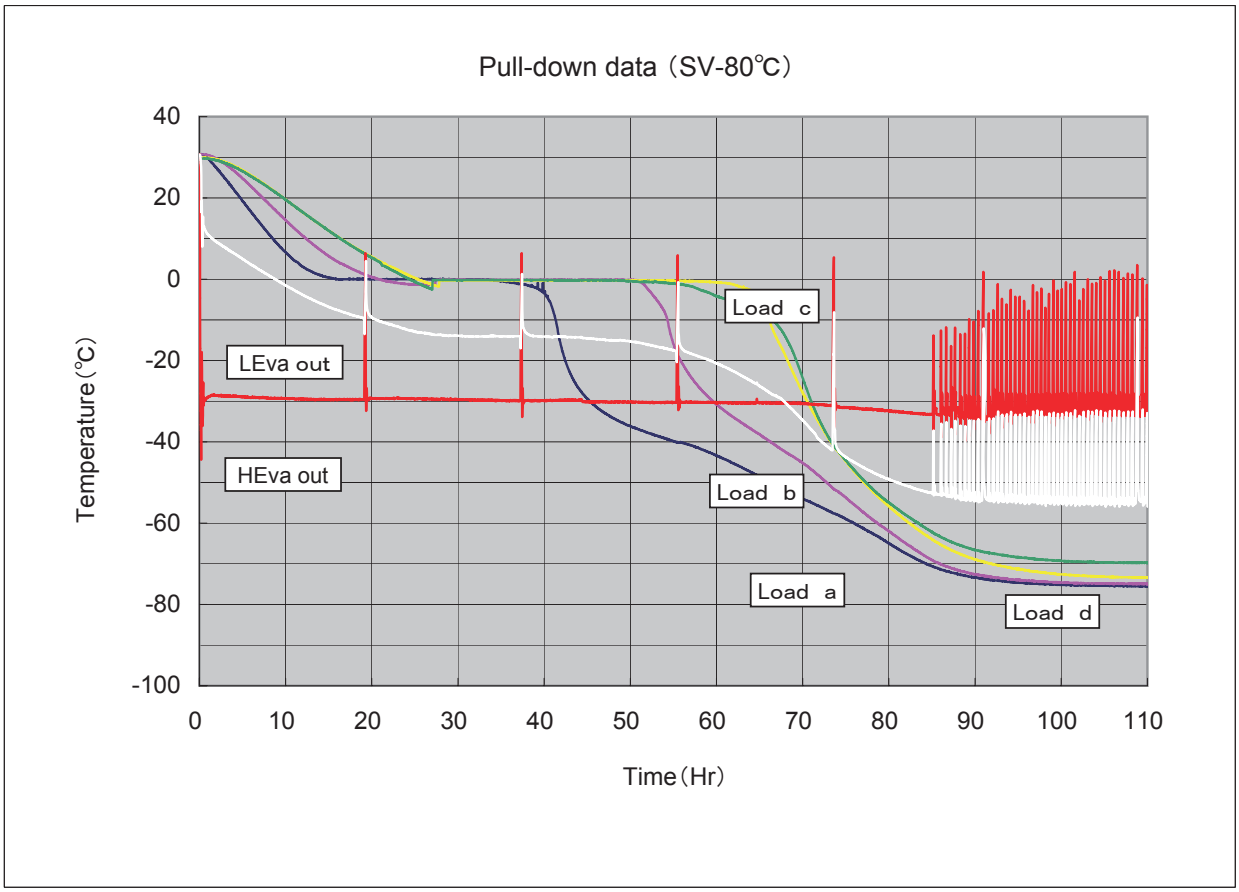

AT30℃ 60Hz SV=-70℃
-60
-62
-64
-66
-68
-70
-72
-74
-76
-78
-80
Chamber temp[℃]
0:00
30
60
90
120
150
180
Time[Minute]
⑮
⑰
⑩
⑤
⑯

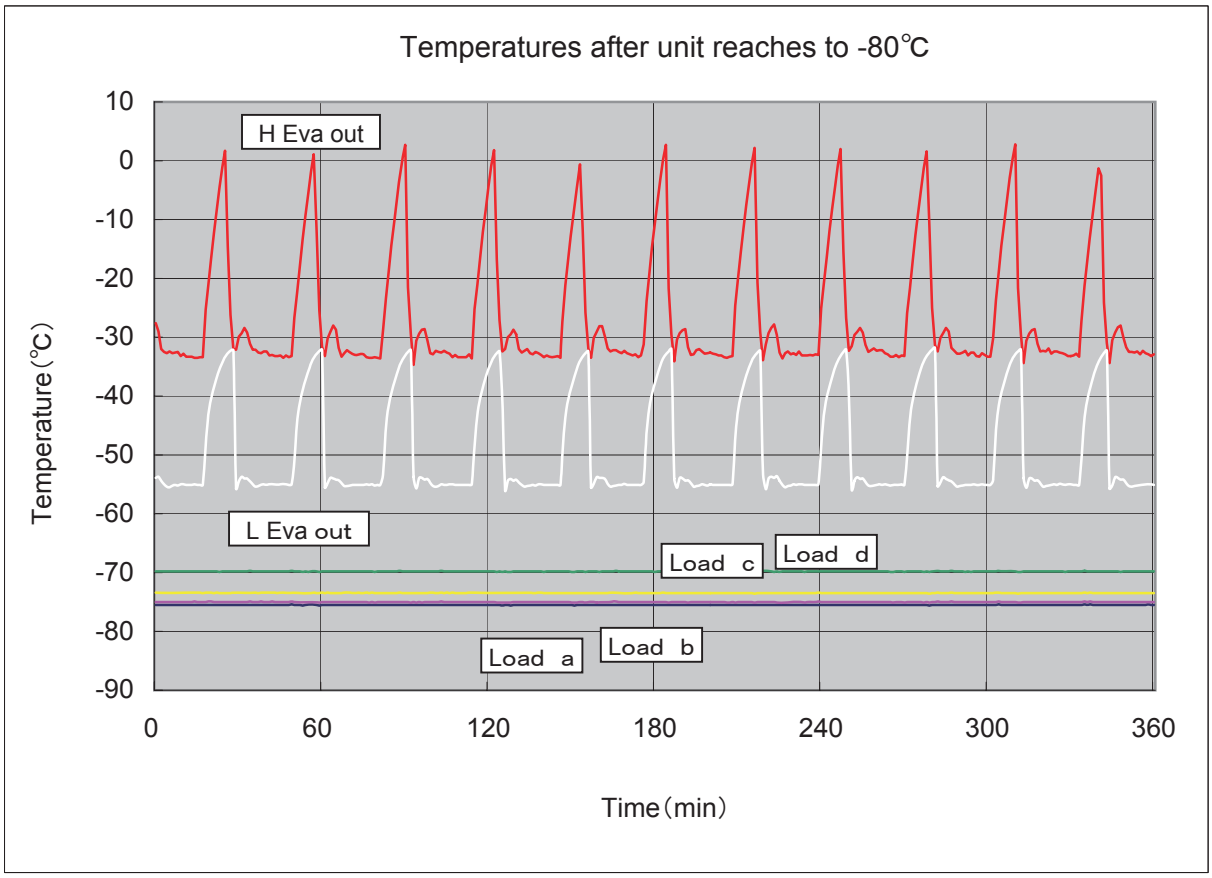
Sample load test

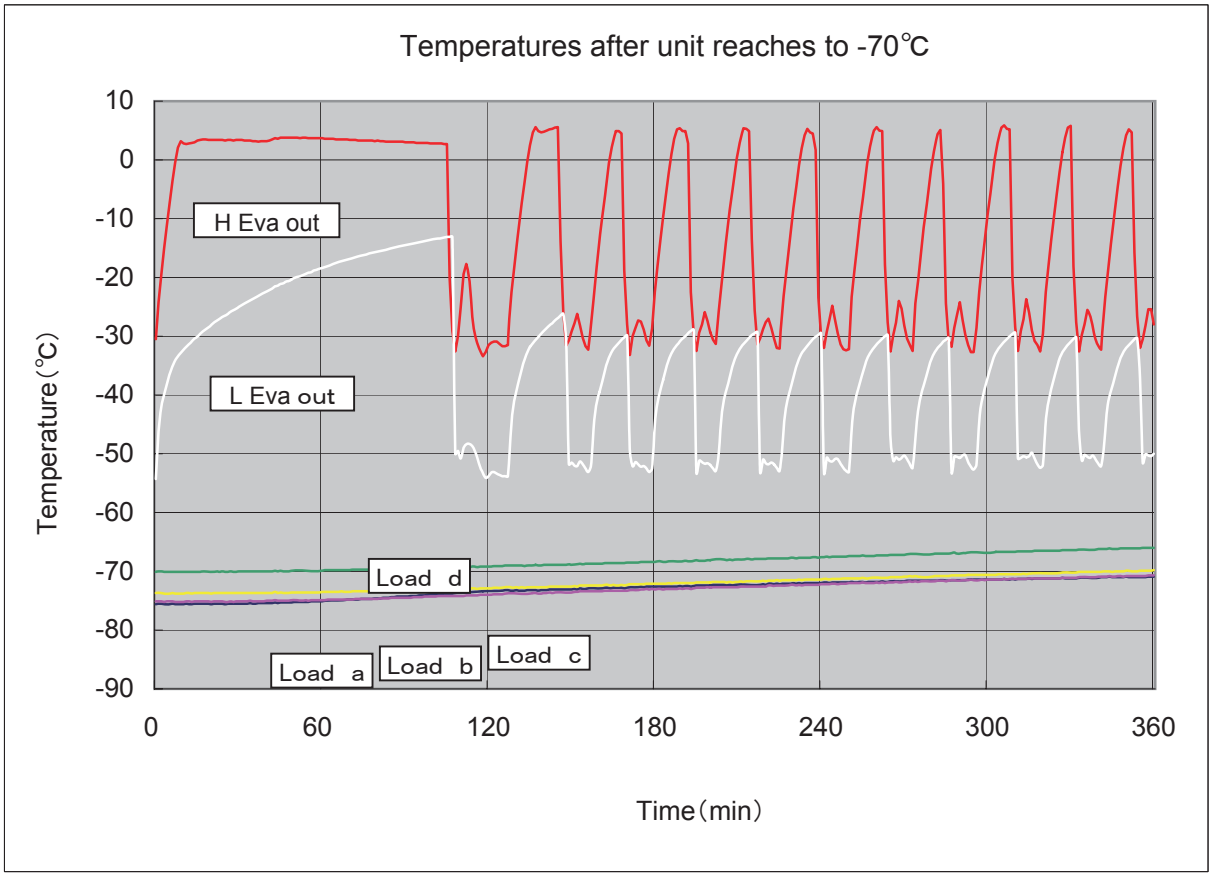
Note) Following data are the reference only.

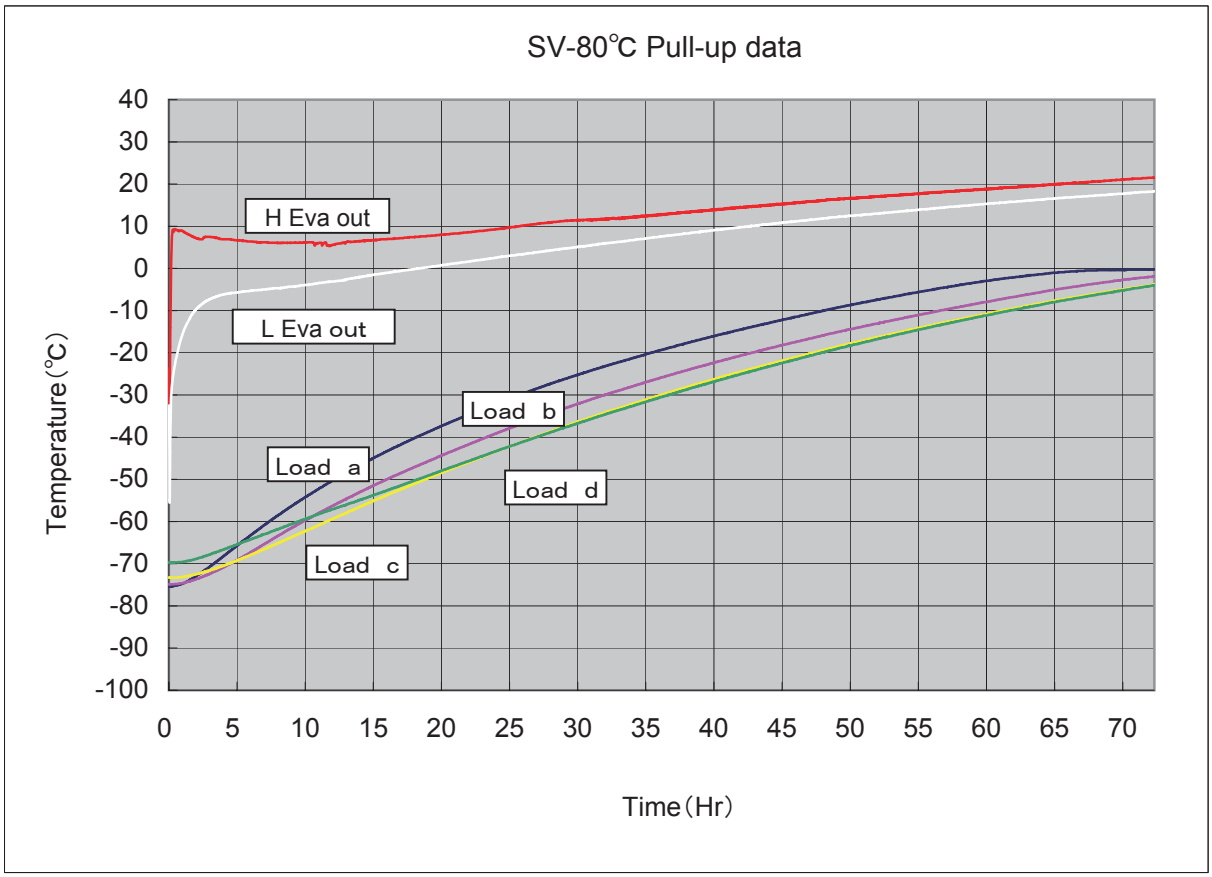
<Condition>
500ml water x 240 bottles（Total:120L）
Measuring points: a, b, c, d, H EVA OUT, L EVA OUT
Ambient temperature: 30℃






Temperatures after unit reaches to -80℃
Temperature(℃)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
60
120
180
240
300
360
Time(min)
H Eva out
L Eva out
Load a
Load b
Load c
Load d


Temperatures after unit reaches to -70℃
Temperature(℃)
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
0
60
120
180
240
300
360
Time(min)
H Eva out
L Eva out
Load d
Load a
Load b
Load c


SV-80℃ Pull-up data
Temperature(℃)
Time(Hr)
H Eva out
L Eva out
Load a
Load b
Load c
Load d
40
30
20
10
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
0
5
10
15
20
25
30
35
40
45
50
55
60
65
70